I-5

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

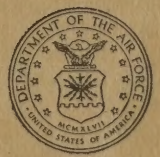
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-5120

TO 33A1-5-65-1

FREQUENCY METER

AN/URM-32 AND AN/URM-32A



DEPARTMENTS OF THE ARMY AND THE AIR FORCE

MAY 1957

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 180-volt plate circuits, or if using Power Supply PP–1243/U on the 115/230-volt ac and dc line connections.

DON'T TAKE CHANCES!

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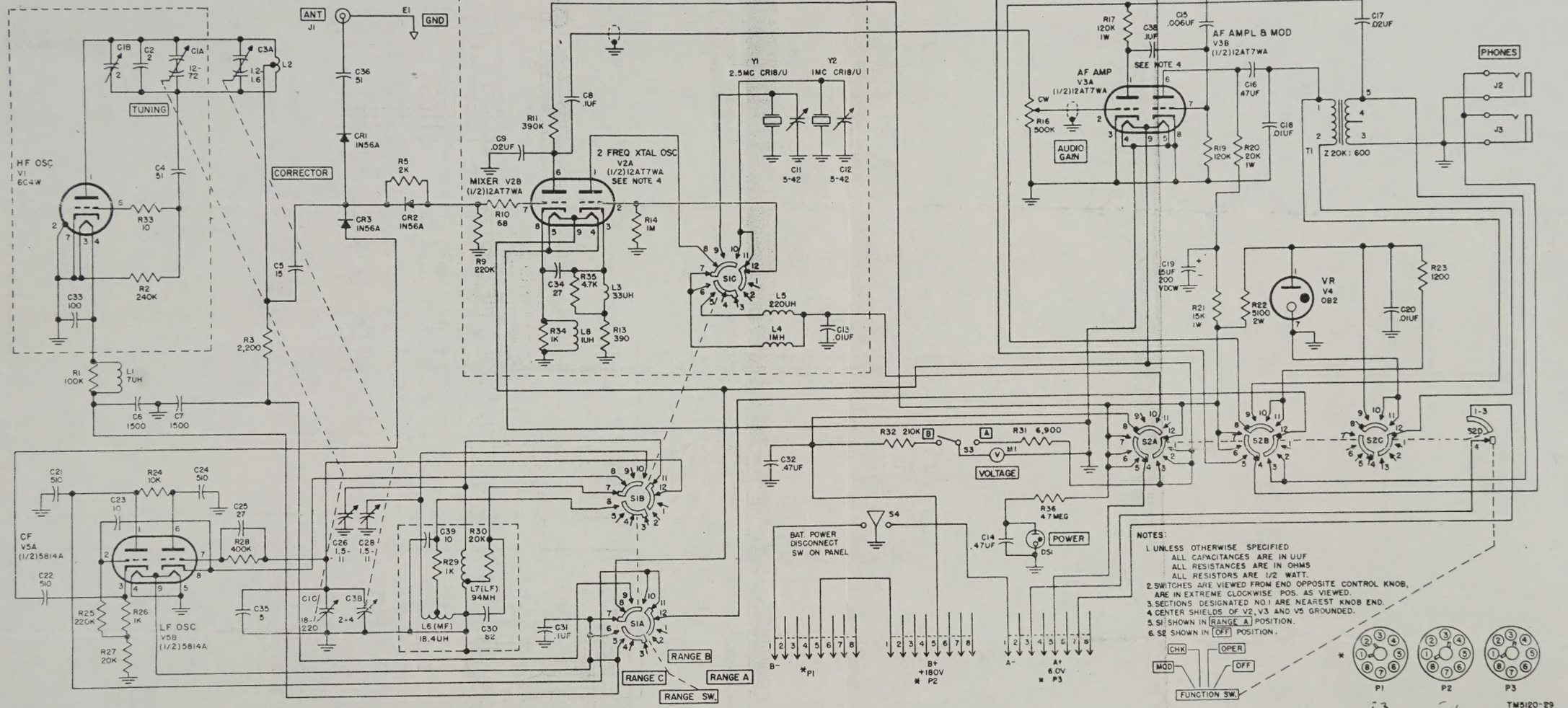


Figure 24. Frequency Meter AN/URM-32, schematic diagram.

TECHNICAL MANUAL
No. 11-5120
TECHNICAL ORDER
33A1-5-65-1

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *28 May 1957*

FREQUENCY METER AN/URM-32

		Paragraph	Page
CHAPTER 1.	INTRODUCTION		
Section I.	General	1, 2	3
II.	Description and data	3–8	3
CHAPTER 2.	INSTALLATION AND OPERATION		
Section I.	Service upon receipt of equipment	9–11	6
II.	Controls and operation	12–16	8
CHAPTER 3.	ORGANIZATIONAL MAINTENANCE		
Section I.	Tools, equipment, and preventive maintenance	17–20	16
II.	Troubleshooting at organizational maintenance level	21–25	19
CHAPTER 4.	THEORY		
Section I.	Theory of Frequency Meter AN/URM-32	26, 27	22
II.	Circuit analysis	28–34	23
CHAPTER 5.	FIELD MAINTENANCE		
Section I.	Troubleshooting at field maintenance level	35–42	30
II.	Repairs	43, 44	38
III.	Calibration and alinement	45, 56	39
IV.	Final testing	47–52	41
CHAPTER 6.	SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE		
Section I.	Shipment and limited storage	53, 54	43
II.	Demolition of materiel to prevent enemy use	55, 56	43
INDEX		....	47

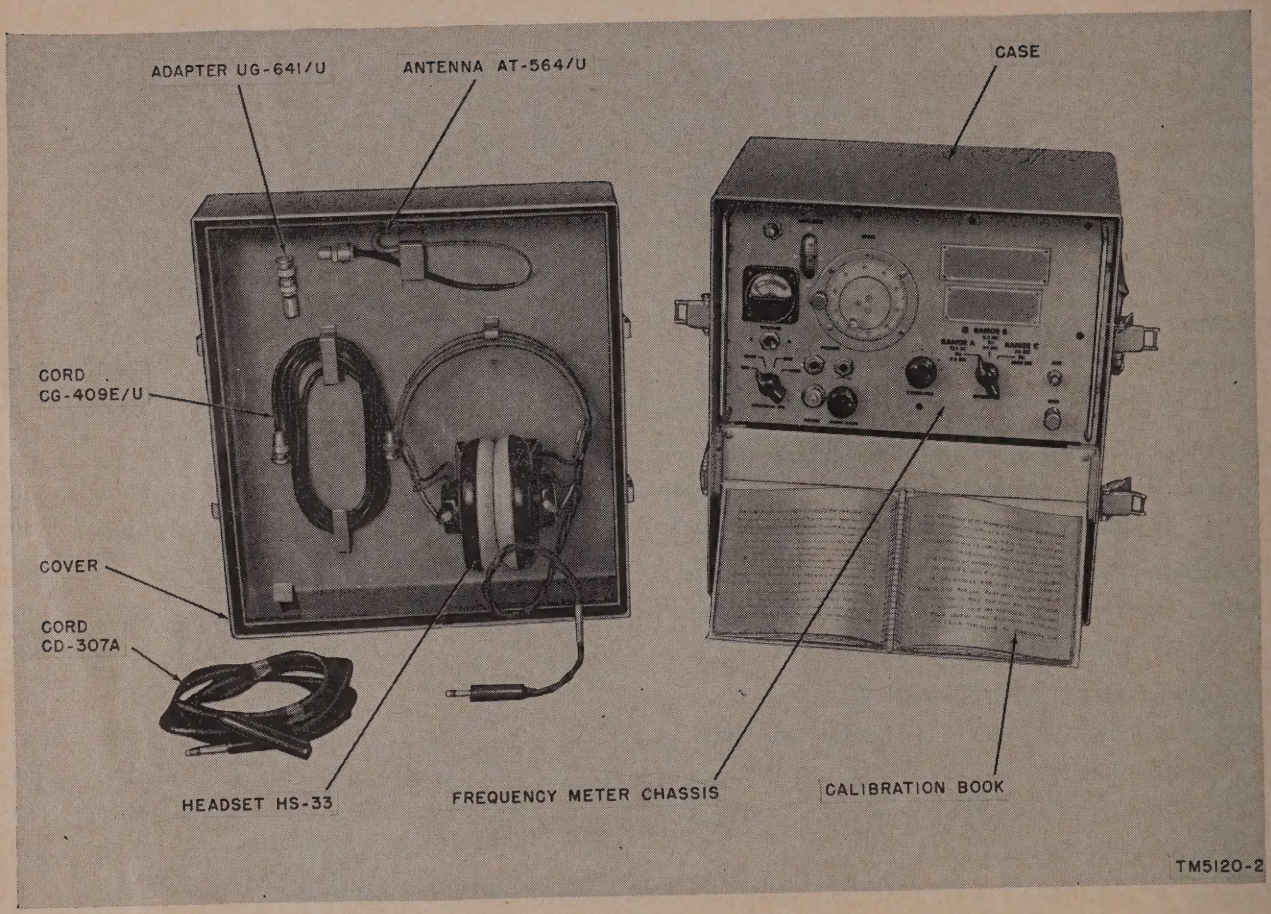


Figure 1. Frequency Meter AN/URM–32.

CHAPTER 1

INTRODUCTION

Note: FREQMETER AN/URM-32 AND AN/URM-32A ARE SIMILAR. INFO IN THIS MANUAL APPLIES TO BOTH

Section I. GENERAL

1. Scope

a. This manual covers installation, operation, maintenance, and repair of Frequency Meter AN/URM–32 (fig. 1).

b. Forward all comments on this publication directly to the Commanding Officer, United States Army Signal Publications Agency, Fort Monmouth, N. J.

2. Forms

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) to Commanding Officer, U. S. Army Signal Equipment Support Agency, Fort Monmouth, N. J., as prescribed in AR 700–38.

b. Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army).

c. Preventive Maintenance Forms.

(1) Prepare DA Form 11–238 (Operator First Echelon Maintenance Check List for Signal Corps Equipment—Radio Communication, Direction Finding, Carrier, Radar) (fig. 8), in accordance with instructions on the back of the form.

(2) Prepare DA Form 11–239 (Second and Third Echelon Maintenance Checklist for Signal Corps Equipment — Radio Communication, Direction Finding, Carrier, Radar) (fig. 9), in accordance with instructions on the back of the form.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Frequency Meter AN/URM–32 (fig. 1) is a self-contained instrument used to measure frequencies in the range from 125 kilocycles (kc), to 1,000 megacycles (mc). It is also used as a signal generator which provides a choice of modulated or unmodulated signals for testing and calibrating radio equipment.

4. Technical Characteristics

Frequency range:

Range A .....125 kc to 2.5 mc.
Range B .....2.5 mc to 65 mc.
Range C .....65 mc to 1,000 mc.

Output voltage range:

Accuracy and sensitivity:

Sensitivity...With an rf input signal of .1 volt an af output of .05 mw minimum is obtained.

Accuracy.....01 per cent (−4 F. to +125° F.).

Radio frequency 100 uv minimum across an external 50-ohm resistive load.

Power input:

6 volts dc.....1 ampere.
180 volts dc.....25 milliamperes.
Number of tubes.5.
Weight.....27 lb (less batteries or power supply).

5. Components of Frequency Meter AN/URM–32

a. Components. The components of Frequency Meter AN/URM–32 (fig. 1) are listed in the following table:

Quantity	Item	Height (in.)	Depth (in.)	Width (in.)	Unit weight (lb)
	Frequency Meter AN/URM–32 consists of—	$13\frac{11}{16}$	$11\frac{31}{32}$	$13\frac{13}{16}$	27
	Antenna AT–564/U			12 (long)	$\frac{1}{32}$
	Cord CG–409E/U			12 (long)	1/5
	Adapter UG–641/U				$\frac{1}{32}$
	Headset HS–33				$1\frac{1}{3}$
	Cord CD–307A			60 (long)	$\frac{1}{32}$
1 set	Running spares (*b* below)				
2	TM 11–5120				

b. Running Spares. The following running spares are stored in the meter case (fig. 2).

Quantity	Item
1	Electron tube, OB2
1	Electron tube, 12AT7WA
1	Electron tube, 5814A
1	Electron tube, 6C4W

6. Nomenclature and Common Name

Nomenclature and common names of the components of Frequency Meter AN/URM–32 follow:

Nomenclature	Common name
Frequency Meter AN/URM–32	Meter
Antenna AT–564/U	Antenna
Adapter UG–641/U	Adapter
Headset HS–33	Headset
Cord CG–409E/U	Rf cable
Cord CD–307A	Headset extension cord

7. Description

a. Frequency Meter AN/URM–32. The meter (fig. 1) is a five-tube heterodyne meter used for measuring unknown frequencies in the 125-kc to 1,000-mc range. It is inclosed in a two-section case. The top section contains the chassis and control panel, and the bottom section is the battery (or power supply) compartment. A circuit label is on the bottom of the chassis cover plate. A detachable cover protects the operating controls when the equipment is not in use and opens the interlock switch when closed. The cover also contains the headset, headset extension cord, antenna, RF cable, and adapter. All of the controls and connectors of the meter are on the front panel. The calibration book, which contains a list of dial settings and corresponding frequencies produced by the meter, is installed on a sliding panel in front of the battery compartment.

b. Accessories. The following accessories are supplied with the meter:

(1) *Antenna AT–564/U, cord CG–409E/U, and adapter UG–641/U.* The antenna is equipped with an insulated hooked end, which makes it easy to attach near the equipment being tested. Cord CG–409E/U is the RF cable which connects the antenna to the ANT jack on the front panel of the meter. Adapter UG–641/U converts the ANT BNC connector to a pigtail clamp connector and may be used with suitable cable to connect meter input or output to remote equipment located beyond the range of the RF cable.

(2) *Headset HS–33 and cord CD–307A.* The headset is the low-impedance type which, when connected to the PHONES jack on the meter front panel through the headset extension cord, provides the operator with the necessary audible indication of the heterodyne signal.

(3) *Miniature tube puller and No. 8 socket head wrench* (fig. 2). The tube puller is provided as an aid to removing the miniature tube 6C4W of the meter. When properly used, the puller will prevent bent or broken tube pins and permit removal of the 7 pin tube while still hot. The socket head wrench is supplied for easy unit disassembly.

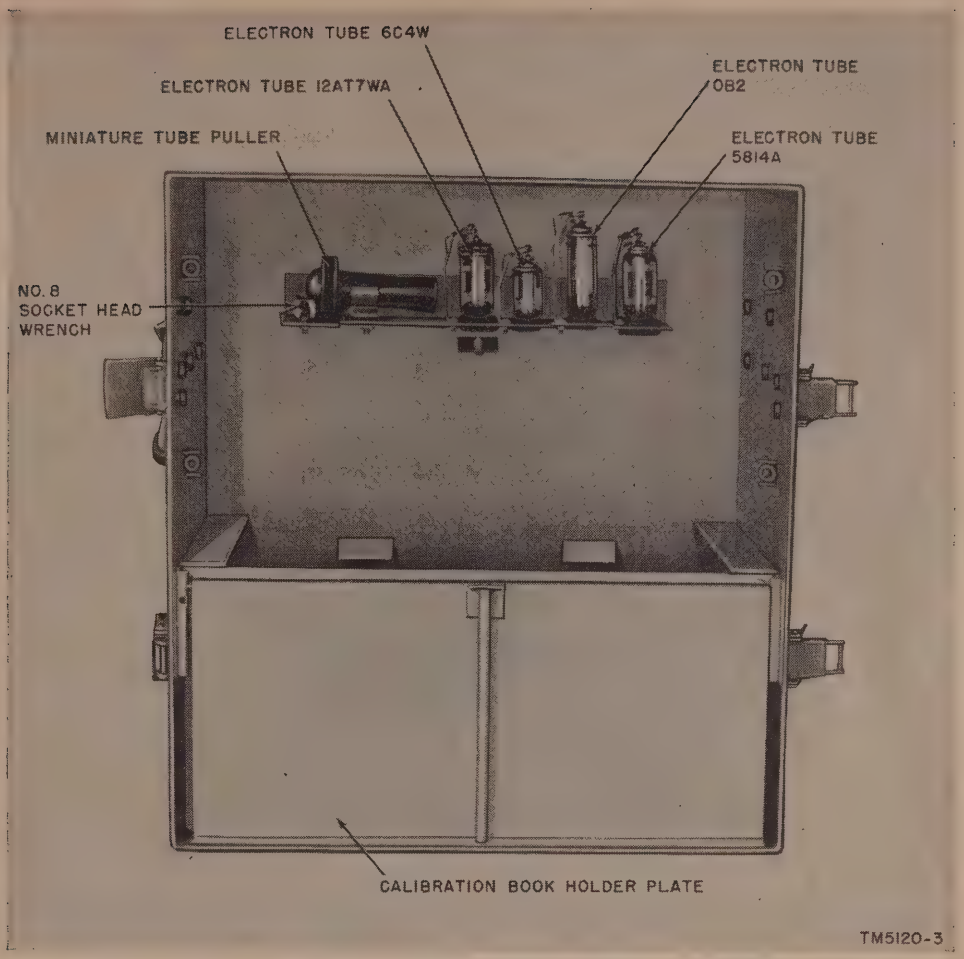


Figure 2. Running spares for Frequency Meter AN/URM–32.

8. Additional Equipment Required

The following equipment is *not* supplied with the meter but is required for its operation.

a. Batteries. Two Batteries BA–419/U and one Battery BA–412/U are required for use with the meter.

b. Power Supply PP–1243/U. The power supply is 12 inches long, 4½ inches wide, and 5½ inches high. It clamps into the battery rack of the meter. The input voltage required is 115/230 volts alternating current (ac), 50 to ~~400~~ 1000 cycles per second (cps). The output power is 180 volts direct current (dc) at 25 milliamperes (ma) and 6.3 volts ac at 1.1 ampere.

8,1 DIFFERENCE IN MODELS
SEE C-1

CHAPTER 2

INSTALLATION AND OPERATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

9. Unpacking

a. Packaging Data. When packaged for shipment, the meter is placed in a moisture-vaporproof container and packed in a wooden box. A typical shipping box and its contents is shown in figure 3. Two meters are packed in one wooden box. The packaged box is 19¾ inches high, 33 inches wide, and 18¾ inches deep. It has a volume of 5.3 cubic feet and weighs 102 pounds.

b. Removing Contents. Perform the following (fig. 3):

(1) Cut and fold back the metal straps.

(2) Remove the nails from the top and one side of the box with a nail puller. Remove the top and one side. Do not attempt to pry them off because the equipment may become damaged.

(3) Open the moistureproof outer paper wrapping that covers the outer carton inside the box. Remove the carton.

(4) Open the outer carton and the moisture-vaporproof barrier within the outer carton. Remove the inner cartons. Open the inner cartons and remove the contents.

10. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has become damaged, refer to paragraph 2.

b. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the meter against the table of components in paragraph 5.

c. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If modified, the MWO number will appear on the front panel near the nomenclature plate. Check to see that this MWO number also appears on the schematic diagram of the manual accompanying the equipment. If not, add a note to the overall schematic diagram.

11. Installation of Equipment

Instructions for installation of the batteries and tubes and for connecting the meter are as follows:

a. Batteries.

(1) Remove the front cover from the case by unlatching the four fasteners.

(2) Lift the calibration book holder plate at the bottom and remove from its mountings. Remove the battery cover plate by removing two machine screws at top.

(3) Connect the three electrical plug connectors to their respective electrical receptacle connectors in the two Batteries BA–419/U and the one Battery BA–412/U. (Connectors are polarized to prevent misconnection.)

(4) Insert the connected batteries into the battery compartment as shown in figure 4. Replace the battery cover plate.

(5) Replace the calibration book holder plate.

(6) Replace the front cover on the case and close the latch fasteners.

b. Tubes. Electron tubes for the meter are installed in their sockets when shipped.

c. Connections. Place the meter as close as possible to the equipment that is to be tested.

(1) Battery connections are explained in *a* above.

(2) If Power Supply PP–1243/U is used in place of batteries, connect the meter to Power Supply PP–1243/U with the same plug connectors used for making the battery connections.

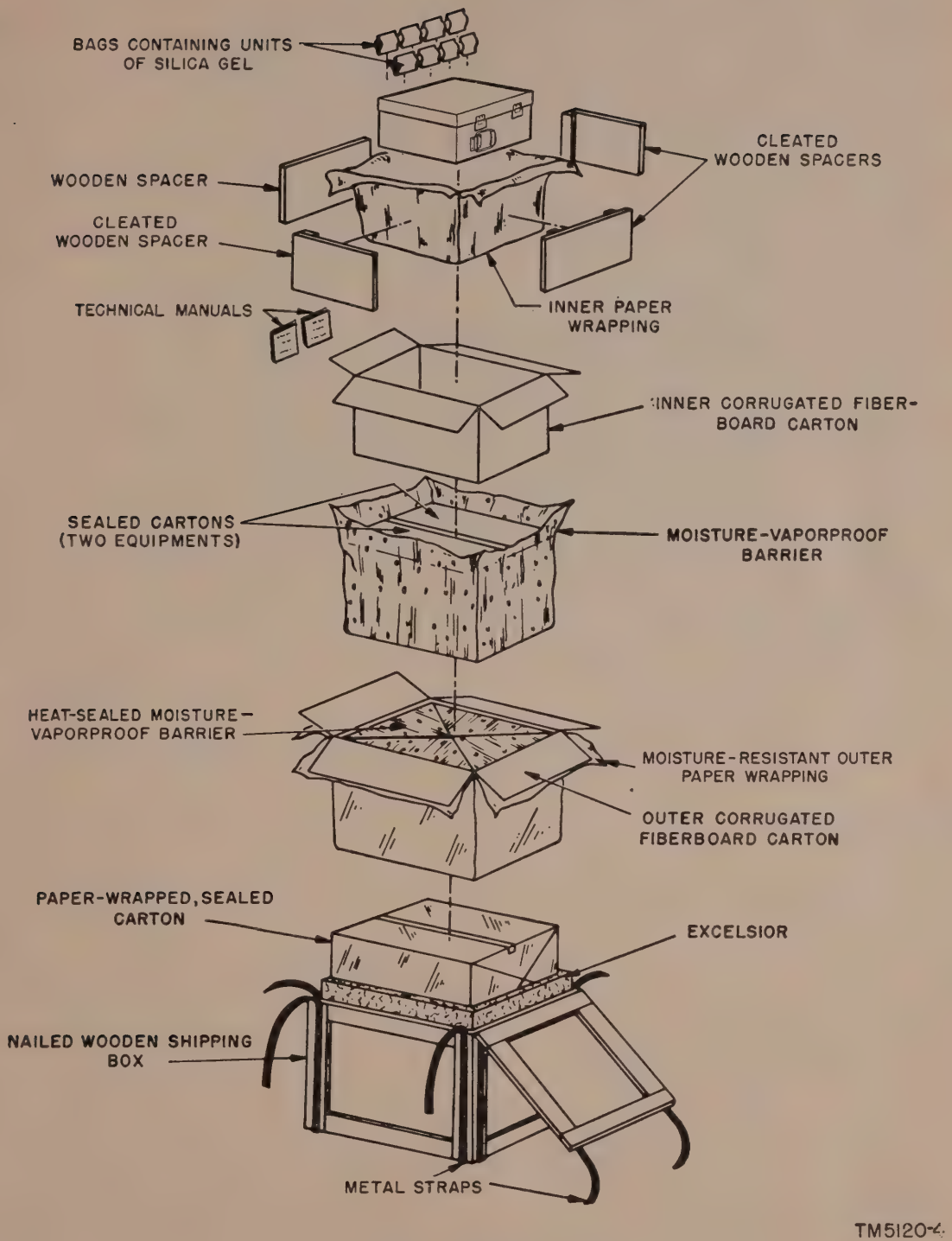


Figure 3. Typical packaging.

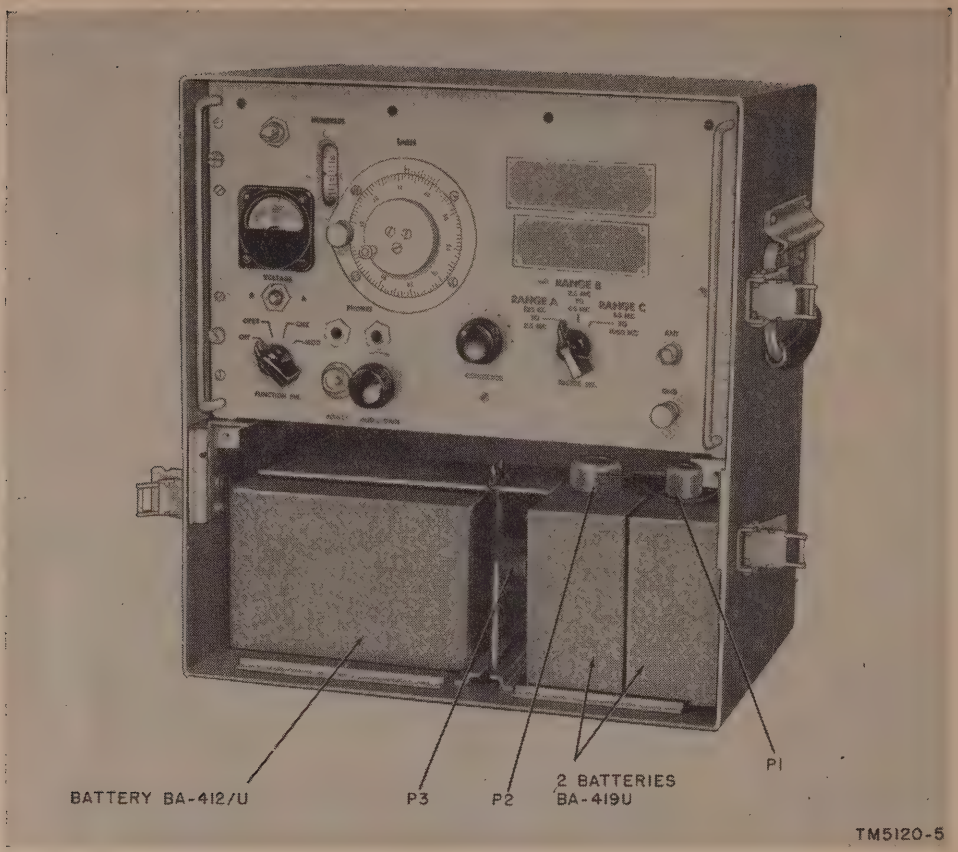


Figure 4. Frequency Meter AN/URM–32, battery compartment.

Section II. CONTROLS AND OPERATION

12. Operating Controls
(fig. 5)

The operating controls and their functions are listed below—

Control	Function
FUNCTION SW.	A four-position switch: *Position* — *Function* OPER — Permits the heterodyne oscillator to be used to determine the frequency of a received signal or to radiate a signal from the meter at the frequency to which the meter is set. The crystal oscillator is off in this position. MOD — Enables the AF amplifier to be used as an audio oscillator for plate modulating the vfo selected by the RANGE SW. CHK — Enables the vfo selected by the RANGE SW. to be checked against the crystal oscillator for frequency accuracy. OFF — Turns off meter.
AUDIO GAIN CORRECTOR	Adjusts audio output to the headset.
	Adjusts frequency of vfo selected by RANGE SW. to coincide with main dial calibration points (after calibration).
RANGE SW.	Selects the range of frequencies in which the meter is to operate.
VOLTAGE switch and meter.	In A position, meter indicates filament voltage condition. In B position, meter indicates B+ voltage condition.
Dial HUNDREDS	Indicates dial setting of the meter in hundreds.
Dial UNITS	Subdivides each division on the dial HUNDREDS control into 100 parts for greater accuracy.

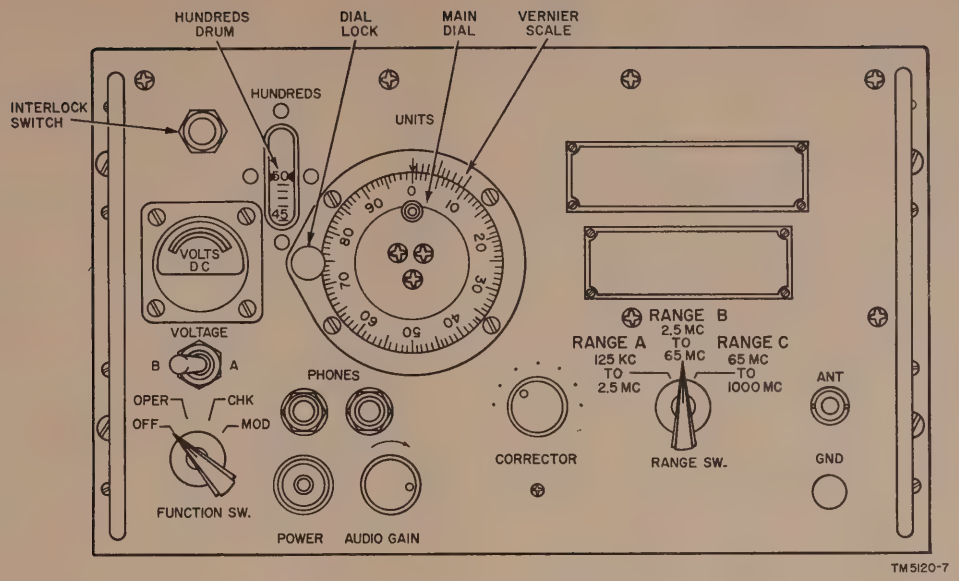


Figure 5. Frequency Meter AN/URM–32, controls.

13. Starting Procedure

Perform the starting procedure given below before using the operating procedures described in paragraph 15.

a. Starting.

(1) Open the meter cover.

(2) Plug the headset into one of the PHONES jacks.

(3) Turn the FUNCTION SW. to the CHK position and allow the tubes to heat for 15 minutes.

Note. Allow the set to warm up in temperatures where it will actually be used when making measurements. If the meter is to be used outdoors, allow the set to warm up outdoors. Do not turn on the set in a warm room and then take it out into the cold because the measurements may not be accurate.

(4) Tune the main dial (*b* below) to one of the crystal check points located in the calibration book. Figure 6 illustrates the proper method for interpreting the dial scale.

(5) Check for a zero beat (par. 26) in the headset. If the zero beat is not obtained at the correct dial setting as indicated by the calibration book, the CORRECTOR knob, which is a vernier control for variable frequency oscillator (vfo) frequency, can be varied until zero beat is obtained.

Note. If two or more beats are heard in the range of the CORRECTOR control when calibrating the dial against a crystal check point, always zero beat on the stronger of the two.

b. Main Dial. The drum indicates in hundreds (HUNDREDS), the main dial in units (UNITS), and the vernier scale (above and on the outside edge of the main dial) in tenths. The use of these indicators is explained in (1) through (5) below.

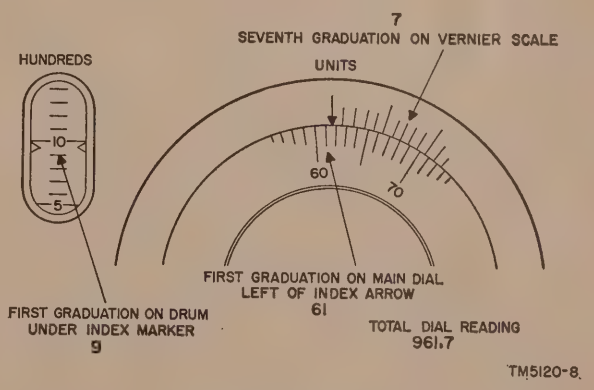


Figure 6. Interpretation of vernier scale on outer ring of main dial.

(1) Assume that a setting corresponding to 961.7 is desired.

(2) Turn the main dial until the 9 graduation on the HUNDREDS drum (fig. 6) is directly under the index line on the HUNDREDS window.

(3) Turn the main dial counterclockwise until the 61 graduation on the UNITS scale is directly opposite the index arrow on the vernier scale.

(4) Continue turning the main dial counterclockwise slowly until the seven-tenths graduation on the vernier scale exactly coincides with a graduation on the UNITS scale.

(5) Reading the dial is the reverse of inserting a setting. The first graduation on the vernier scale, clockwise from the index arrow, which coincides with a graduation on the UNITS scale is the dial setting in tenths: the UNITS graduation under, or to the left of, the vernier scale index arrow is the dial setting in units; and the graduation on the HUNDREDS drum under, or below, the index line on the window is the dial setting in hundreds.

14. Calibration Book

(fig. 7 OR 7.1)

* The calibration book is kept in the front of the meter chassis compartment on a sliding holder which permits positioning the book for easy reading. It contains a list of the dial settings and the corresponding frequencies (fundamental and harmonic) produced by the meter at these dial settings. The calibration book supplied with any particular meter applies *only* to that particular meter and must *not* be used with any other meter. The meter produces both fundamental and harmonic frequencies for each given dial setting, and several different frequencies are listed for each dial setting. The first five pages of the calibration book contain condensed descriptive and operational text; use these pages as a convenient reference guide. The balance of the book is divided into three sections, each section corresponding to the frequency range selected by the RANGE SW. Each section contains an index of crystal check points, an index of pages for the frequencies covered by that range, and the frequency tabulation pages listing frequencies and corresponding dial settings. Across the top of each frequency tabulation page in these sections is an index to the frequencies tabulated on that page. The index lists the first and last frequency appearing in each page, fundamental and harmonic.

a. The first section covers the frequency range from 125 kc to 2.5 mc (RANGE A position). An index of 22 crystal check points in the range is listed on the first page of the section. In the first section, the fundamental, second harmonic, fourth harmonic, and eighth harmonic of the frequencies generated by the low-frequency (lf) vfo are tabulated in the FREQUENCY columns for the fundamental range from 125 kc to 200 kc. The 10th harmonic is tabulated from 200 kc to 250 kc.

b. The second section covers the frequency range from 2.5 mc to 65 mc (RANGE B position). An index of 22 crystal check points in the range is listed on the first page of the section. In the second section, the fundamental, second harmonic, fourth harmonic, and eighth harmonic of the frequencies generated by the lf vfo are tabulated in the FREQUENCY columns for the fundamental range from 2.5 mc to 2.999 mc. The 13th harmonic is tabulated from 3 mc to 5 mc.

c. The third section covers the frequency range from 65 mc to 1,000 mc (RANGE C position). An index of 27 crystal check points in the range is listed on the first page of the section. In the third section, the fundamental, second harmonic, fourth harmonic, and eighth harmonic of the frequencies generated by the high-frequency (HF) vfo are tabulated in the FREQUENCY columns for the fundamental range from 65 mc to 130 mc.

d. To find the dial reading corresponding to a given frequency, follow the procedures outlined below:

(1) Turn to the section corresponding to the range covering the given frequency; refer to the page index in the section.

(2) Locate the number of the page that contains the given frequency.

(3) Examine the column index at the top of the page to determine the columnar listing of the given frequency (columns are tabulated in ascending numerical sequence).

(4) Locate the given frequency in the correct column. Find the dial setting corresponding to the given frequency on the same line under the column titled DIAL.

e. To find the frequency that corresponds to a given dial setting, follow the procedures outlined below—

(1) Open the calibration book to the page on which the main dial setting is listed.

(2) Look down the left hand column of dial settings until the setting nearest the desired frequency is found.

* CALIBRATION TABLE FORMATS SHOWN IN FIGURES 7 & 7.1 ARE ALTERNATES. EITHER FORMAT IS USED IN THE A MODEL

FREQUENCY RANGE KC

180.0KC TO 184.9KC (.180MC TO .1849MC)
360.0KC TO 369.8KC(.360MC TO .3698MC)

DIAL	FREQUENCY			
2340.0	180.0	360.0	720.0	1440.0
2343.6	180.1	360.2	720.4	1440.8
2347.2	180.2	360.4	720.8	1441.6
2350.8	180.3	360.6	721.2	1442.4
2354.4	180.4	360.8	721.6	1443.2
2358.0	180.5	361.0	722.0	1444.0
2361.6	180.6	361.2	722.4	1444.8
2365.2	180.7	361.4	722.8	1445.6
2368.8	180.8	361.6	723.2	1446.4
2372.4	180.9	361.8	723.6	1447.2
2376.0	181.0	362.0	724.0	1448.0
2379.6	181.1	362.2	724.4	1448.8
2383.2	181.2	362.4	724.8	1449.6
2386.8	181.3	362.6	725.2	1450.4
2390.4	181.4	362.8	725.6	1451.2
2394.0	181.5	363.0	726.0	1452.0
2397.7	181.6	363.2	726.4	1452.8
2401.3	181.7	363.4	726.8	1453.6
2404.9	181.8	363.6	727.2	1454.4
2408.5	181.9	363.8	727.6	1455.2
2412.1	182.0	364.0	728.0	1456.0
2415.7	182.1	364.2	728.4	1456.8
2419.3	182.2	364.4	728.8	1457.6
2422.9	182.3	364.6	729.2	1458.4
2426.5	182.4	364.8	729.6	1459.2

CRYSTAL CHECK POINT

2301.3	181.818

720.0KC TO 739.6KC (.720MC TO .7396MC)
1440.0KC TO 1479.2KC (1.440MC TO 1.4792MC)

DIAL	FREQUENCY			
2430.1	182.5	365.0	730.0	1460.0
2433.7	182.6	365.2	730.4	1460.8
2437.3	182.7	365.4	730.8	1461.6
2440.9	182.8	365.6	731.2	1462.4
2444.5	182.9	365.8	731.6	1463.2
2448.1	183.0	366.0	732.0	1464.0
2451.7	183.1	366.2	732.4	1464.8
2455.3	183.2	366.4	732.8	1465.6
2458.9	183.3	366.6	733.2	1466.4
2462.5	183.4	366.8	733.6	1467.2
2466.1	183.5	367.0	734.0	1468.0
2469.7	183.6	367.2	734.4	1468.8
2473.3	183.7	367.4	734.8	1469.6
2476.9	183.8	367.6	735.2	1470.4
2480.5	183.9	367.8	735.6	1471.2
2484.1	184.0	368.0	736.0	1462.0
2487.7	184.1	368.2	736.4	1472.8
2491.3	184.2	368.4	736.8	1473.6
2494.9	184.3	368.6	737.2	1474.4
2498.5	184.4	368.8	737.6	1475.2
2502.1	184.5	369.0	738.0	1476.0
2505.7	184.6	369.2	738.4	1476.8
2509.3	184.7	369.4	738.8	1477.6
2512.9	184.8	369.6	739.2	1478.4
2526.5	184.9	369.8	739.6	1479.2

CRYSTAL CHECK POINT

2301.3	181.818

TM5120-9

Figure 7. Frequency Meter AN/URM–32, calibration book.

(3) Locate the corresponding frequency in the appropriate column to the right, on the same line, as the given dial setting.

Note. When accuracy is required and the dial reading or frequency being sought falls between listings in the calibration book, exact interpolation should be made. The method for interpolating for frequency readings and dial settings is explained in *f* and *g* below.

f. When the meter is being used to measure an unknown frequency, the observed dial setting may fall between two values listed in the calibration book. To aid in the calculation of the exact frequency which corresponds to this unlisted dial setting, a mathematical process known as interpolation can be used. The process of interpolation can best be explained by the following example:

(1) Assume that the observed dial setting is 2374.4 and that it is desired to determine the exact frequency reading corresponding to this dial setting. Further assume that the frequency is known to be in the 250- to 500-kc band.

(2) The dial setting 2374.4 is not listed in the calibration book (fig. 7). By examining the dial setting columns, note that 2374.4 falls between 2372.4 and 2376.0. The frequencies corresponding to these dial settings are 361.8 kc and 362.0 kc, respectively. Therefore, the exact frequency corresponding to the dial setting 2374.4 must lie between these two listed frequencies. Tabulate the information thus obtained as follows:

Dial settings	*Corresponding frequencies (kc)*
2376.0	362.0
2374.4	F
2372.4	361.8

(3) From this tabulation, obtain the total differences for dial settings and frequency readings by subtracting the lesser listed dial setting from the greater listed dial

setting, and by subtracting the lesser listed frequency reading from the greater listed frequency reading. The difference obtained in the first problem is 3.6 (divisions) and in the second problem, .2 (kc).

2376.0	362.0
−2372.4	−361.8
3.6	.2

(4) A change of 3.6 in dial reading corresponds to a frequency change of .2 kc. A change of 1 in the dial setting will therefore produce a frequency change of .2 kc divided by 3.6 or—

$$3.6 \overline{)\ .200}\ \ .055 \text{ kc}$$

(5) Obtain the actual difference in dial readings by subtracting the lower listed reading from the actual reading, or—

Actual reading	2374.4
Lower reading	−2372.4
Difference	2.0

(6) To get the change in frequency, multiply the frequency change per unit of dial reading in (4) above by the actual difference in (5) above or—

Dial difference	2
Change in f per unit	.055 kc
Change in frequency	.110 kc

(7) Since the actual dial setting (2374.4) is higher than the referenced calibration point (2372.4), add the change in frequency (.11 kc) to the referenced calibration point frequency (361.8 kc) thus—

Reference calibration frequency	361.8
+Change (increase) in frequency	.11
Actual frequency	361.91 kc

g. When the meter is being used to calibrate a radio transmitter, the desired transmitter frequency may fall between two values listed in the calibration book. Interpolation may also be used in this case to determine the exact dial setting. The procedures for interpolating dial settings is shown as follows:

(1) Assume that the transmitter frequency is 361.85 kc and that it is desired to determine the exact dial setting corresponding to this frequency reading.

(2) Although the frequency reading 361.85 kc is not shown in the calibration book (fig. 7), examination of the frequency reading columns discloses that this frequency falls between 361.8 kc and 362.0 kc. These frequency values correspond to dial setting values of 2372.4 and 2376.0, respectively. Therefore, the exact dial setting for the frequency reading 361.85 must fall between these two listed dial settings. Tabulate this information as follows:

Dial settings	*Corresponding frequencies (kc)*
2376.0	362.00
D	361.85
2372.4	361.80

(3) From this tabulation, obtain the dial settings and frequency reading differences in the same manner as prescribed for frequency interpolation ($f(3)$ and $f(5)$ above)—

2376.0	362.0	361.85
−2372.4	−361.8	−361.80
3.6	.2	.05

(4) Therefore 3.6 dial settings are equal to .2 kc. Divide .2 kc by 3.6 dial settings

$$3.6 \overline{)\ .200} = .055 \text{ kc}$$

Result: 1 dial setting is equal to .055 kc.

(5) Divide the result obtained in the right hand column of (3) above by the result obtained in (4) above.

.05 divided by .055 = .9 dial setting

(6) Add the calculated dial setting in (5) above to the lower listed dial setting to obtain the exact dial setting corresponding to the transmitter frequency.

	2372.4
+	.9
	2373.3 = unknown dial setting

h. The exact interpolation methods demonstrated in *f* and *g* above are accurate for all FREQUENCY columns in the calibration book. When such a high degree of accuracy is not required, select the midpoint reading between the two listed values. The error introduced by this approximation method of interpolation will be quite small and will work equally well for either unlisted dial settings or unlisted frequency readings.

15. Operation

a. Tuning Transmitter to Desired Frequency, Approximate Frequency Known.

(1) With the RANGE SW. in the desired position and the FUNCTION SW. in the CHK

position, set the main dial to the nearest crystal check point and adjust the CORRECTOR control for zero beat.

(2) Turn the FUNCTION SW. to the OPER position.

(3) Refer to the calibration book to determine the dial setting for the desired frequency and turn the main dial of the meter to this setting. Lock the main dial. Turn the AUDIO GAIN control fully clockwise.

(4) Couple the meter antenna to the transmitter output.

Note. Do not couple the meter directly to a transmitter. If the transmitter is feeding a nonradiating load, place the probe position of the antenna near the circuits that carry the rf currents. If the power output is low, place the probe in the transmitter near the oscillator coil or cavity. If the transmitter is connected to an antenna or other radiating load, place the probe portion of the antenna in the radiated field. The separation needed for best coupling varies from 1 foot to 20 or 30 feet, depending on the power radiated from the transmitter antenna.

(5) Tune the transmitter to give a zero beat in the headset. If it is impossible to get a zero beat, set the transmitter tuning to the middle of the audio beat.

Note. It is often impossible to get a true zero beat because of the presence of frequency modulation. If no zero beat can be obtained, the proper setting for best accuracy is obtained by tuning to the midpoint of the audio note.

b. Measuring Frequency of Local Transmittter.

(1) *When approximate frequency is known.* To measure the frequency of a local transmitter when the approximate frequency of the transmitter is known, proceed as follows:

(*a*) With the FUNCTION SW. in the CHK position, set the main dial to the nearest crystal check point and adjust the CORRECTOR control for zero beat.

(*b*) Turn the FUNCTION SW. to the OPER position.

(*c*) Couple the meter to the transmitter. Turn the main dial to the approximate frequency. Tune on both sides of this main dial setting until a zero beat is heard in the headset.

(*d*) Open the calibration book to the page that shows the dial setting of the zero beat note and read the corresponding frequency.

(2) *When approximate frequency is unknown.* To measure the frequency of a local transmitter when the approximate frequency of the transmitter is not known, first use an absorption-type wavemeter or radio receiver to determine the approximate frequency. Then follow the procedures outlined in (1) above. When an absorption-type wavemeter or radio receiver is not available, determine the approximate transmitter frequency by an empirical and mathematical process as follows:

(*a*) Place the RANGE SW. in the RANGE B position.

(*b*) Put the FUNCTION SW. in the CHK position and calibrate the vfo at the nearest crystal check point to 30 mc; use the CORRECTOR knob.

(*c*) Place the FUNCTION SW. in the OPER position and turn the main dial from the low to the high end of range B, while listening carefully for beat notes. Record the dial settings for the beat notes heard.

(*d*) If the unknown frequency is above 60 mc, more than one beat note should be heard; this indicates that consecutive harmonics of the vfo signal are beating with the unknown transmitter frequency signal. For example, if the unknown frequency was 120 mc, consecutive harmonic beat notes would be obtained at the sixth harmonic of 20 mc, the fifth harmonic of 24 mc, the fourth harmonic of 30 mc, and the third harmonic of 40 mc. Determine the vfo fundamental frequencies corresponding to the dial settings for any two adjacent zero-beat points, as instructed in paragraph 14*h*; then substitute these values in the following equation and solve the equation to determine the unknown transmitter frequency:

$$F_x = \frac{F_l \times F_h}{F_h - F_l}$$

F_x = unknown frequency
F_l = lower consecutive harmonic
F_h = higher consecutive harmonic

c. Tuning Continuous Wave Receiver to Desired Frequency.

(1) With the FUNCTION SW. in the CHK position, set the main dial to the nearest crystal check point and adjust the CORRECTOR control for zero beat.

(2) Turn the FUNCTION SW. to the OPER position.

(3) Turn the main dial to the correct dial setting for the desired frequency, as obtained from the calibration book.

(4) Couple the meter antenna to a radio receiver (referred to as receiver) and tune the receiver to produce an audible tone.

(5) Adjust the tuning control of the receiver to a zero beat.

Note. If the receiver has a beat oscillator, turn it on and tune in the signal from the meter in the same manner as tuning for any other signal. If the receiver is of the regenerative type, advance the regenerative control until the detector starts to oscillate. In this condition, the receiver will respond to continuous-wave (cw) signals and may be set to a frequency in the same manner as a receiver having a beat oscillator.

(6) When checking receivers with a beat oscillator, sometimes it is difficult to get a true zero beat. In this case, adjust the receiver to the middle of the audio note. No appreciable error will result.

d. Tuning Receiver to Desired Frequency, When Receiver Has No Means of Producing Beat Note.

(1) With the FUNCTION SW in the CHK position, set the main dial to the nearest crystal check point and adjust the CORRECTOR control for zero beat.

(2) Set the main dial at the dial setting that corresponds to the desired frequency and set the FUNCTION SW. at MOD.

(3) Couple the meter loosely to the receiver and tune the receiver for greatest output in the receiver headset.

e. Measuring Frequency of Distant Transmitter. This measurement requires the use of a radio receiver (referred to as receiver) together with the meter. Use the following procedure.

(1) Tune in the signal from the distant transmitter on the receiver, and determine the approximate frequency from the receiver dial setting or from the receiver calibration.

Note. If the transmission is cw, use either a receiver with a beat oscillator or a regenerative type receiver. Turn on the beat oscillator or turn up the regeneration control until the receiver oscillates. Tune the receiver to zero beat.

(2) Turn off the beat oscillator or adjust the regenerative receiver to a nonoscillating condition before proceeding.

(3) With the FUNCTION SW. in the CHK position, correct the frequency of the vfo to the calibration at the crystal check point nearest the approximate frequency indicated by the receiver dial.

(4) Set the FUNCTION SW. to OPER.

(5) Couple the meter to the receiver antenna lead. While listening to the receiver with a headset, turn the main dial of the meter in the region of the approximate frequency until a beat note or whistle is heard in the receiver headset. Tune the meter until the beat note is as near to zero beat as possible.

Note. It may be necessary to vary the coupling between the meter and the receiver to obtain a satisfactory beat note. When the received transmitter signal is strong, the coupling must be loose; when the transmitter signal is weak, the coupling must be correspondingly tighter. Vary the coupling by changing the distance between the ANT jack and the antenna on the meter or the spacing between the meter and the receiver.

(6) Refer to the dial setting in the calibration book and read the corresponding frequency.

f. Measuring Frequency to Which Receiver is Tuned.

(1) With the FUNCTION SW. in the CHK position, set the main dial to the nearest crystal check point and adjust the CORRECTOR control for zero beat.

(2) Place the FUNCTION SW. in the OPER position.

(3) Couple the meter to the receiver.

(4) If the receiver has a beat oscillator, turn it on. Then turn the main dial of the meter to a position near the approximate frequency and tune until zero beat is heard in the receiver headset.

(5) Read the main dial of the meter and look

up the corresponding frequency in the calibration book.

(6) If the receiver has no local beat oscillator, turn the FUNCTION SW. to the MOD position and adjust the meter to give maximum output in the receiver headset.

16. Stopping Procedure

a. Turn the FUNCTION SW. to the OFF position.

b. Remove the headset from the jack.

c. Disconnect the antenna cord.

d. Close the front cover of the cabinet.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE

Section I. TOOLS, MATERIAL, AND PREVENTIVE MAINTENANCE

17. Tools and Materials

Tools and materials used, but not supplied, with the meter are listed in *a* and *b* below:

a. Tools.

1 Tool Equipment TE–41
1 Tool TL–597/U

b. Materials.

Cleaning cloth
Fine sandpaper
Cleaning Compound (Federal Stock No. 7930–395–9542)

18. General Preventive Maintenance Techniques

a. Use fine sandpaper to remove corrosion.

b. Use a clean dry cloth or a dry brush for cleaning. If necessary, clean the parts with a cloth moistened with cleaning compound; wipe the parts dry.

Caution: Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.

19. Use of Preventive Maintenance Forms

a. DA Form 11–238 (fig. 8) is a preventive maintenance checklist to be used by the operator. Items not applicable to the meter are lined out in the figure. Instructions for the use of the form appear on the back of the form.

b. DA Form 11–239 (fig. 9) is a preventive maintenance checklist to be used by the unit repairman. Items not applicable to the equipment are lined out in the figure. Instructions for the use of the form appear on the back of the form.

20. Lubrication

The only required lubrication point for the meter is the worm gear of the large variable capacitor. Figure 10 shows the location of the gearbox. Remove the gear housing and apply a small amount of light grease to the point of contact of the worm gear and the spur. Rotate the shaft of the capacitor several times back and forth to work the grease into the gears. Replace the gear housing.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
FREQUENCY METER AN/URM 32	10

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (~~receiver~~, ~~transmitter~~, ~~carrying cases~~, wire and cable, ~~microphones~~, tubes, spare parts, technical manuals and accessories).		✓	✓				
2	LOCATION ~~AND INSTALLATION~~ SUITABLE FOR NORMAL OPERATION.		✓	✓				
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONE~~, HEADSETS, ~~CHESTSETS~~, ~~KEYS~~, JACKS, PLUGS, ~~TELEPHONES, CARRYING BAGS~~, COMPONENT PANELS.		✓	✓				
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: ~~TUBES~~, LAMPS, CRYSTALS, ~~FUSES~~, CONNECTORS, ~~VIBRATORS, PLUG-IN COILS AND RESISTORS.~~		✓	✓				
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~WORN OR CHIPPED GEARS, MISALIGNMENT~~, POSITIVE ACTION.		✓	✓				
6	CHECK FOR NORMAL OPERATION.		✓	✓				

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, ~~RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES~~, AND CABLE CONNECTIONS.	✓	13	~~INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.~~	
8	INSPECT CASES, ~~MOUNTINGS, ANTENNAS, TOWERS~~, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.	✓	14	CLEAN ~~AIR FILTERS, BRASS NAME PLATES~~, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	✓
9	INSPECT CORD, CABLE, WIRE, ~~AND SHOCK MOUNTS~~ FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.	✓	15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	✓
10	~~INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.~~		16	INSPECT ~~SHELTERS AND~~ COVERS FOR ADEQUACY OF WEATHERPROOFING.	✓
11	~~INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.~~		17	~~CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.~~	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ~~ELECTRICAL TRANSFORMERS, POWER STATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS~~, AND PILOT LIGHT ASSEMBLIES.	✓	18	~~CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.~~	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM5120-10

Figure 8. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS.—See other side

EQUIPMENT NOMENCLATURE: FREQUENCY METER. AN/URM-32 | EQUIPMENT SERIAL NO.: 10

LEGEND FOR MARKING CONDITIONS: ✓ *Satisfactory;* X *Adjustment, repair, or replacement required;* ⊗ *Defect corrected.*
NOTE: *Strike out items not applicable.*

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (~~accessories, transmitter, carrying cases~~, *wire and cable,* ~~microphones~~, *tubes, spare parts, technical manuals, and accessories*).	✓
2	LOCATION ~~AND INSTALLATION~~ SUITABLE FOR NORMAL OPERATION.	✓
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONE~~, HEADSETS, ~~CHESTSETS, KEYS~~, JACKS, PLUGS, ~~TELEPHONES, CARRYING BAGS~~; COMPONENT PANELS.	✓
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS. ~~VIBRATORS, PLUG-IN COILS, AND RESISTORS.~~	✓
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~WORN OR CHIPPED GEARS, MISALINEMENT~~, POSITIVE ACTION.	✓
6	CHECK FOR NORMAL OPERATION.	✓
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, ~~RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES~~, AND CABLE CONNECTIONS.	✓
8	INSPECT CASES, ~~MOUNTINGS, ANTENNAS, TOWERS~~, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.	✓
9	INSPECT CORD, CABLE, WIRE, ~~AND SHOCK MOUNTS~~ FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.	✓
10	~~INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS, AND REFLECTORS.~~	
11	~~INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.~~	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ~~ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS~~, AND PILOT LIGHT ASSEMBLIES.	✓
13	~~INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL, AND SPECIFIC GRAVITY, AND DAMAGED CASES.~~	
14	CLEAN ~~AIR FILTERS, BRASS NAMEPLATES~~, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	✓
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	✓
16	INSPECT ~~SHELTERS AND~~ COVERS FOR ADEQUACY OF WEATHERPROOFING.	✓
17	~~CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.~~	
18	~~CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT, AND GREASE.~~	

NO.	ITEM	CONDITION
19	~~ELECTRON TUBES: INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS, INSUFFICIENT SOCKET SPRING TENSION. CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES.~~	
20	~~INSPECT FILM CUTOUTS FOR LOOSE PARTS, DIRT, MISALINEMENT, AND CORROSION.~~	
21	~~INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION.~~	
22	~~INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS, BURNED, PITTED, CORRODED CONTACTS, MISALINEMENT OF CONTACTS AND SPRINGS, INSUFFICIENT SPRING TENSION, BINDING OF PLUNGERS AND HINGE PARTS.~~	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALINEMENT OF PLATES, AND LOOSE MOUNTINGS.	✓
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION, AND MOISTURE.	✓
25	~~INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT, AND LOOSE CONTACTS.~~	
26	CLEAN AND TIGHTEN SWITCHES, ~~TERMINAL BLOCKS, BLOWERS, RELAY CASES~~, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	✓
27	~~INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS, AND BREAKS.~~	
28	~~CHECK SETTINGS OF ADJUSTABLE RELAYS.~~	
29	~~LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.~~	
30	~~INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.~~	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR ~~TRANSFORMERS, CHOKES~~, POTENTIOMETERS, AND RHEOSTATS.	✓
32	~~INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL LEAKAGE.~~	
33	BEFORE SHIPPING OR STORING—REMOVE BATTERIES.	✓
34	~~INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.~~	
35	~~INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.~~	
36	INSPECT FOR ~~LEAKING WATERPROOF GASKETS~~, WORN OR LOOSE PARTS.	
37	~~MOISTURE AND FUNGIPROOF.~~	

38 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-239 Replaces DA AGO Form 419, 1 Dec 50, which is obsolete. 16—64383-2

TM5120-11

Figure 9. DA Form 11–239.

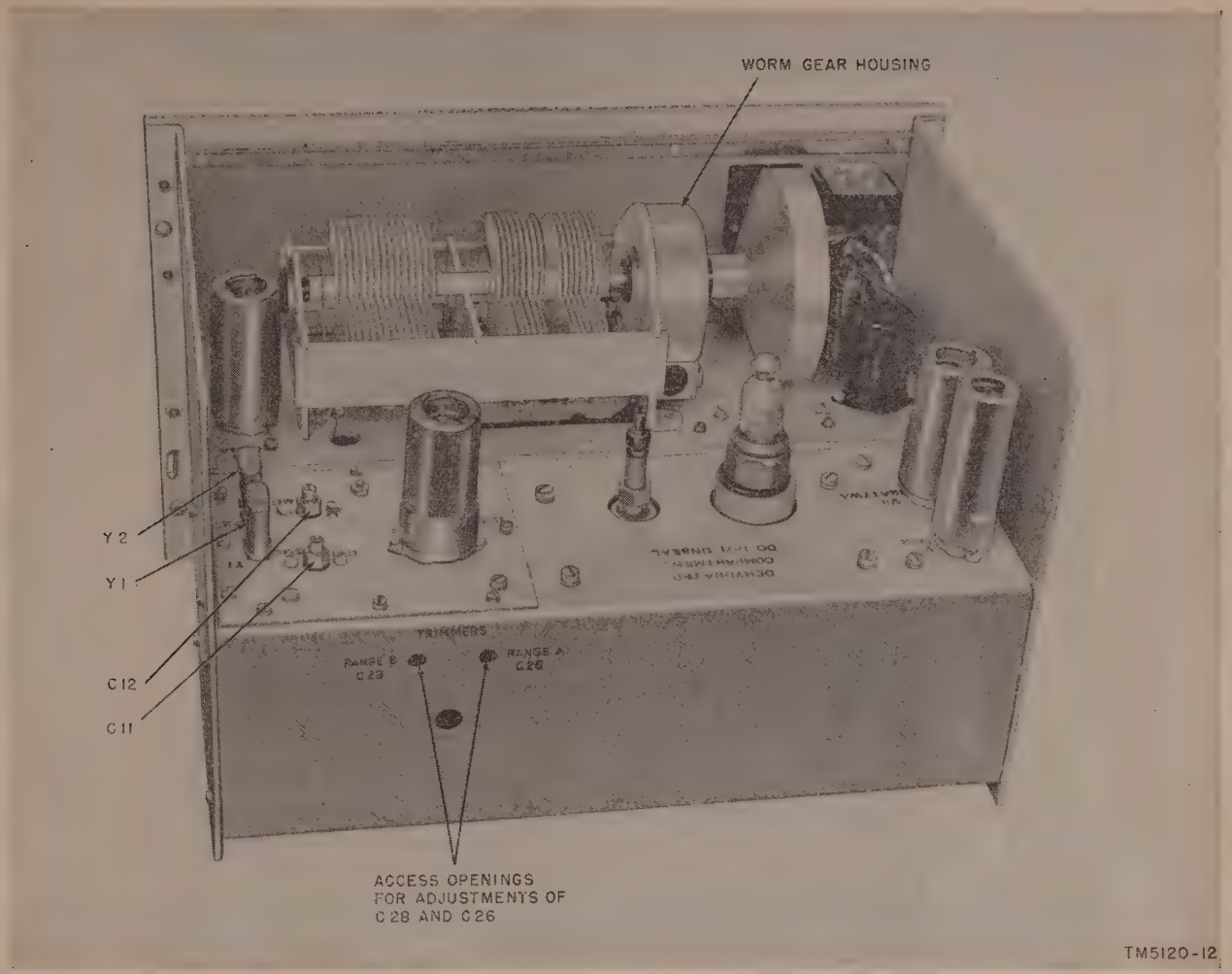


Figure 10. Lubrication point for Frequency Meter AN/URM–32.

Section II. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

21. General

The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and unit repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as broken cords, defective tubes, and cracked insulators. Paragraphs 22 through 25 help in determining which of the circuits is at fault and in localizing the fault to the defective stage or item.

22. Visual Inspection

a. Failure of this equipment to operate properly usually will be caused by one or more of the following faults.

(1) Improperly connected or weak batteries.

(2) Worn, broken, or disconnected cords or plugs.

(3) Wires broken because of excessive vibration.

(4) Defective or loose tubes.

(5) Inactive or loose crystals.

b. When failure is encountered and the cause is not immediately apparent, check as many of these items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

23. Tube Testing Techniques

To prevent the discarding of good electron tubes as faulty, follow the procedures given below when troubleshooting the meter.

a. Inspect all cables, connectors, batteries, and the general condition of the meter before removing the electron tubes.

b. Isolate the trouble, if possible, to a particular section or stage of the meter, and proceed as follows:

(1) If Electron Tube Test Set TV–7/U or equivalent is available, remove and test one tube at a time. Substitute new tubes only for those that are defective.

(2) If a tube tester is not available, troubleshoot by the tube substitution method. Substitute a new tube for an original tube. If no change occurs in the operation of the meter, replace the new tube with the original. Similarly, check each original tube, in turn, until the meter becomes operative or until all suspected tubes have been tested and the need for further troubleshooting is indicated.

24. Troubleshooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 25) will help to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. If the set is completely inoperative or if the recommended corrective measures do not yield results, troubleshooting is necessary.

25. Equipment Performance Checklist

	Step	Unit	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cover	Open to close interlock switch. Turn FUNCTION SW. to OPER position.	POWER lamp lights.	Check lamp; check B battery plugs and voltages.
	2	Cord	Connect to ANT. connector.		
	3	Antenna	Connect to the cord.		
	4	Headset	Connect to PHONES jack.		
START	5	VOLTAGE switch.	Place in A position.	VOLTAGE meter indicates in green area.	Check A batteries, battery plugs, and voltages. Replace batteries.
	6	VOLTAGE switch.	Place in B position.	VOLTAGE meter indicates in green area.	Same as step 5.

	Step	Unit	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	7	RANGE SW.	Place in RANGE A position.		
	8	FUNCTION SW.	Place in CHK position.	Noise heard in headset and beat note heard if tuning dial is set near a crystal check point.	Check headset and headset cord. Check tubes for proper seating and warmth. Be sure tube clamps are in position and tight.
		AUDIO GAIN	Turn clockwise to midposition.		
	9	RANGE SW.	Place in RANGE B position and perform check in step 8.		
	10	RANGE SW.	Place in RANGE C position and perform check in step 8.		
	11	AUDIO GAIN	Turn to maximum clockwise position.	Headset volume increases.	Refer to step 9.
	12	FUNCTION SW.	Place in MOD position.	Rf with 900-cps modulation signal at antenna.	Refer to step 9.
STOP	13	Antenna	Disconnected from the Rf Cable.		
	14	Rf Cable	Disconnected from ANT connector.		
	15	Headset	Disconnected from PHONES jack.		
	16	Cover	Closed to open interlock switch.		

CHAPTER 4

THEORY

Section I. THEORY OF FREQUENCY METER AN/URM–32

26. Heterodyne Principles

a. When two frequencies are present in the input of a mixer circuit, the difference between them will appear in the output circuit as a third frequency. This third difference frequency is called the heterodyne (beat) frequency. If the two original frequencies differ by only a few thousand cycles or less, the resultant beat frequency will be in the audible range. This beat frequency can be amplified and heard in the headset as a definite tone. When two signals are brought closer in frequency to each other (decreasing difference), the tone decreases in pitch until no tone is audible. This is the point of zero beat (where the two original frequencies are exactly the same and their difference value is zero). If one of the two original frequencies is varied beyond the point of zero beat, a low-pitched tone is heard. Further variation, in the same direction, causes a gradual increase in pitch until the tone goes above the audible range.

b. There are two methods of obtaining an audible tone with the meter. The first method is to beat the output of the crystal oscillator against the output of the vfo circuits. The second method is to beat an external RF signal against the output of the vfo circuits. The first heterodyning function is used to calibrate the vfo against the crystal oscillator and the second, to determine the frequency of the external RF signal.

27. Block Diagram

The meter consists of an electrical circuit composed of eight principal parts. Figure 11 shows these parts in block outline. The function of the circuits is described below.

a. Low-Frequency Vfo (V5B). This oscillator generates signals that can be varied from 125 kc to 5 mc.

b. Low-Frequency Harmonic Producer (CR3). This crystal works with the low-frequency vfo and generates harmonics that extend the range of the low-frequency vfo to 65 mc.

c. High-Frequency Vfo (V1). This oscillator generates signals from 65 to 130 mc on fundamental frequencies and up to 1,000 mc on harmonics.

d. Crystal Oscillator (V2A). This oscillator contains two crystals. One crystal is set accurately at 1 mc and the other at 2.5 mc. Both signals contain many strong harmonics. The setting of the RANGE SW. determines which crystal is used.

e. Low-Frequency Mixer (V2B). This circuit mixes two signals together to produce a beat-frequency signal at the output. The two signals may be either:

(1) The vfo signal and any signal received by the meter antenna (when the FUNCTION SW. is in the OPER position).

(2) The vfo signal and the crystal oscillator signal (when the FUNCTION SW. is in the CHK position).

f. High-Frequency Mixer (CR2). This circuit mixes the high-frequency vfo signal and any signal received by the meter antenna to produce a beat-frequency signal at the output.

g. Audio Amplifier (V3A and V3B). This stage amplifies the beat-frequency signal produced in the mixer circuit so that it may be heard in the headset. When the FUNCTION SW. is in the MOD position, V3B functions as an audio oscillator and modulates one of the vfo outputs. Harmonic producer CR1 generates harmonics of the vfo output and the modulated signal is applied to the ANT terminal.

h. Power Supply. The power supply provides operating potentials to all the electron tubes. It may be a battery-type power supply or an ac power supply. Appropriate connections must be made to the three terminal strips.

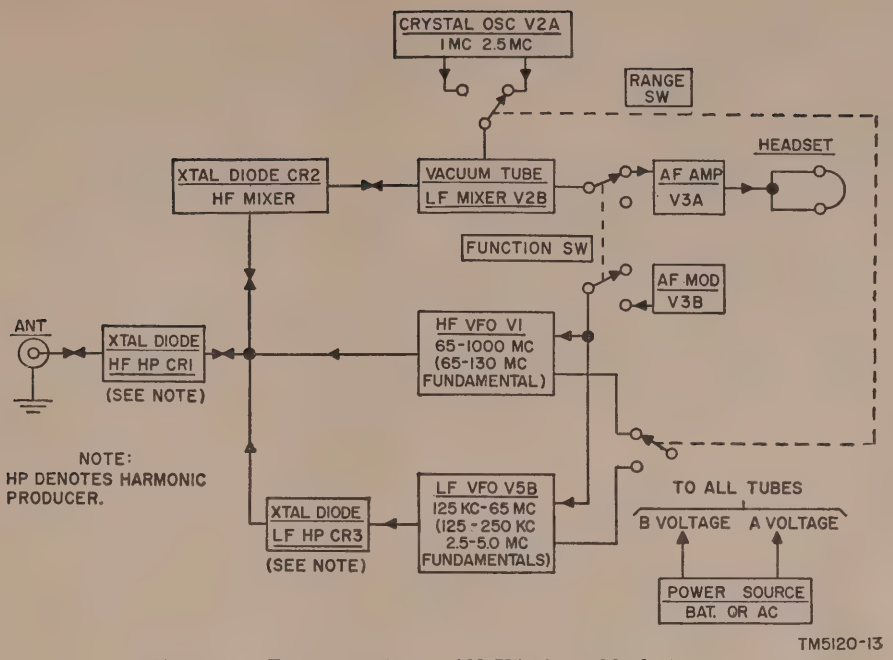


Figure 11. Frequency Meter AN/URM–32, block diagram.

Section II. CIRCUIT ANALYSIS

28. General

The extended frequency coverage of the meter is obtained by using the harmonic component of three fundamental frequency ranges. The RANGE SW. (fig. 12) selects one of these three ranges. RANGE A position covers from 125 KC TO 2.5 MC. RANGE B position covers from 2.5 MC TO 65 MC. RANGE C position covers from 65 MC TO 1000 MC.

29. Crystal Oscillator

(fig. 12 AND Fig 12.1)

a. Two ~~large~~ crystals ~~CR10, 11~~ are used in the oscillator circuit shown in figure 12. 3/12/1 The RANGE SW. selects the 1-mc (Y2) or 2.5-mc (Y1) crystal to provide crystal check points to connect the dial to original calibration settings. The 1-mc crystal provides 22 crystal check points in the RANGE A position and 22 crystal check points in the RANGE B position. Strong beats are obtained at points where the vfo fundamental or harmonic frequencies agree with the fundamental or harmonic frequencies of the crystal. The 2.5-mc crystal provides 27 crystal check points for the RANGE C position, enabling dial correction at 2.5 mc intervals throughout the fundamental range.

b. Trimmers capacitors C11 and C12 are used to adjust the frequency of the crystal units. Periodic adjustments are necessary because of aging of crystals and components. It is also necessary to make readjustments whenever a crystal unit is replaced. Adjustment procedures are given in paragraph 46.

c. Switch S1C connects Y2 (for RANGE A and RANGE B positions) and Y1 (for RANGE C) to the grid of V2A. Resistor R14 is the grid-return resistor for this circuit.

d. In the RANGE A and RANGE B positions of the RANGE SW. L4 is switched into the plate circuit of V2A. In the RANGE C position, L5 is switched into the plate circuit. The tube interelectrode capacitance combines with these inductors to form a resonant tank circuit. Capacitor C13 bypasses the RF component around the power source.

e. In the cathode circuit L3 increases the high-frequency harmonic component characteristic for this circuit. Coil L3 is shunted by R35 which prevents intermittent oscillations from occurring when plate voltage is removed from V2A. Self-bias for this stage is provided by R13.

f. The output of the crystal oscillator is coupled from the cathode circuit to mixer stage V2B by C34.

g. Heater current for V2A is supplied through FUNCTION SW. S2A in all switch positions except OFF.

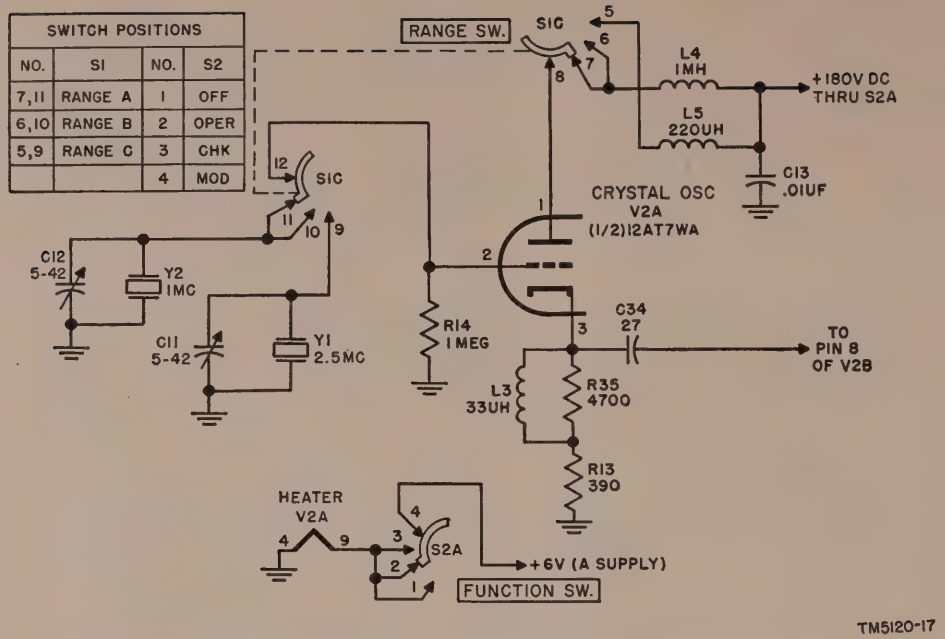


Figure 12. Crystal oscillator, simplified schematic diagram.

FREQ METER AN/URM-32

30. Low-Frequency Oscillator and Cathode Follower

(fig. 13)

a. The low-frequency oscillator is the vfo for ranges A and B. Tube V5B is used in a modified Hartley oscillator circuit, the output of which is applied through C23 to cathode follower V5A.

b. The oscillator tank circuit consists of C1C, C3B, C35, L7, and C26 for RANGE A position or L6 and C28 for RANGE B position. The main resonating components are C1C and L7 or L6. The position of RANGE SW. S1 determines the fundamental frequency range for this vfo. CORRECTOR trimmer capacitor C3B is used to calibrate the frequency of the vfo to the frequency of the crystal oscillator at any one of the several crystal check points. The preset trimmers, C26 and C28 are not adjusted except during oscillator alinement procedures. Capacitor C35 compensates for temperature variations.

c. Grid-leak bias is provided by R28 and C25. Cathode bias is provided by R29 or R30, depending on the position of switch S1B. This additional bias increases the frequency stability of the oscillator. The cathode resistors are bypassed by C30 and C39.

d. Feedback is provided through plate bypass capacitor C24 from the plate of V5B to the grounded end of the tank circuit. Resistor R24 is a voltage-dropping resistor for the plate supply. The plate voltage and heater current are obtained through the RANGE SW. S1 and FUNCTION SW. S2. The cathode output of V5B is coupled to the grid (pin 2) of V5A through C23.

e. Tube V5A is connected as a cathode-follower circuit and performs a buffer for the vfo and as an impedance-matching device for the next stage. The grid resistor is R25 in series with cathode resistor R27 which raises the output impedance of V5A. The output signal is developed across R26 and R27 and is coupled to the mixer through C22. Capacitor C21 serves as the plate supply bypass.

31. High-Frequency Oscillator

(fig. 14)

a. The high-frequency oscillator is used for RANGE C. Tube V1 is connected as a modified Colpitts oscillator. The combination of grid-cathode capacitance (Cgk) and plate-cathode capacitance (Cpk) forms a voltage-dividing network which effectively grounds one point on the tank circuit for RF. Feedback in this oscillator is accomplished by interelectrode capacitance with the voltage drop across the grid-cathode capacitance supplying the grid excitation.

b. Capacitors C1A and C3A and inductor L2 combine with the interelectrode capacitance and plate-lead and grid-lead inductances to form the

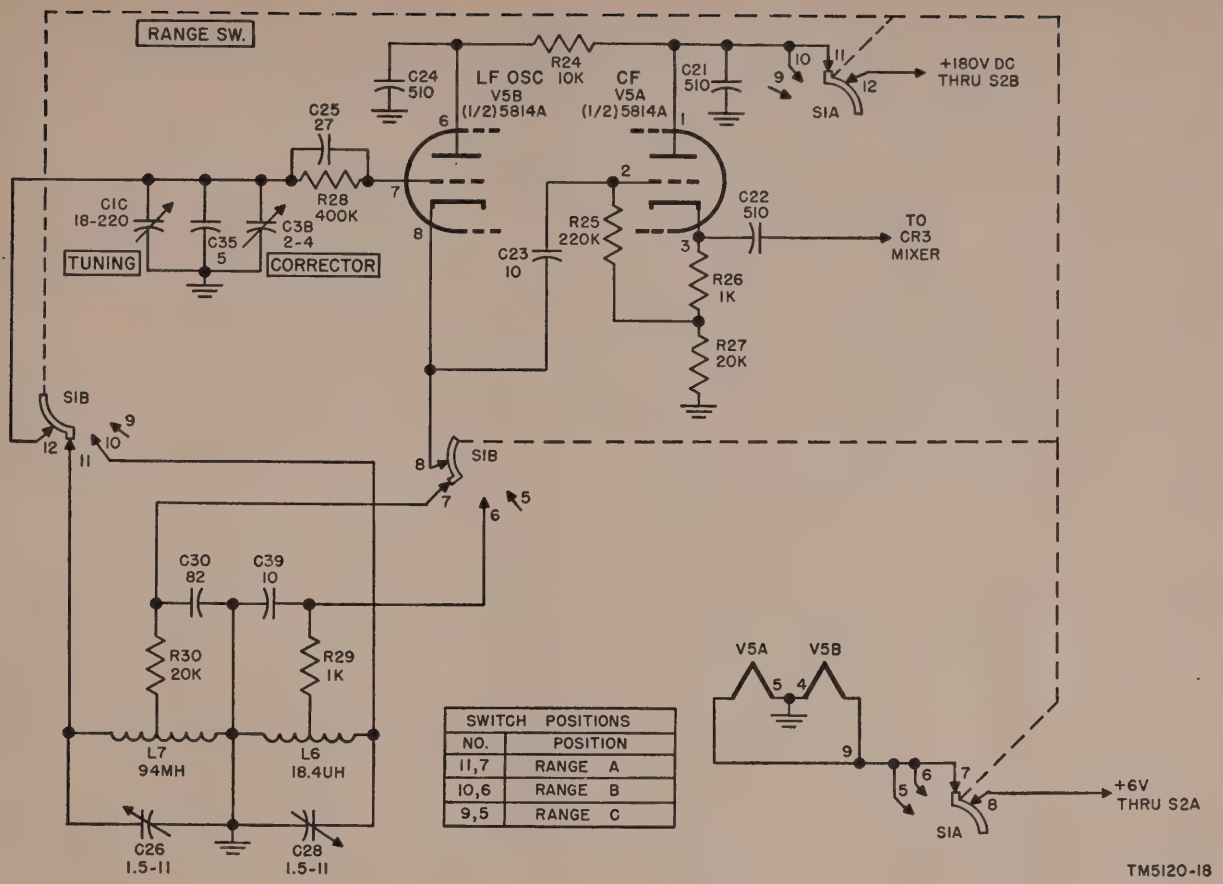


Figure 13. Low-frequency oscillator and cathode follower, simplified schematic diagram.

FREQ METER AN/URM-32

tank circuit. Capacitor C1A is the main tuning capacitor and C3A is the main trimmer capacitor; these components are labeled TUNING and CORRECTOR on the control panel. Capacitor C1B is a preset trimmer which is used to compensate for component aging or replacement. CORRECTOR trimmer C2 permits calibrating the vfo against the crystal oscillator. Resistor R2 and capacitor C4 provide grid-leak bias.

c. The filament circuit is filtered by R1, L1, C33, and C6 which form a high-impedance, broad-band RF filter to prevent the RF component from entering the filament voltage source. In the grid circuit, R33 is used as a parasitic suppressor to improve the frequency stability for this oscillator. The output is developed across R3 and is taken from the tap on L2 and fed through C5 to the mixer circuit. Capacitor C7 is the plate supply bypass.

32. Mixer Circuit

(fig. 15)

a. General. The mixer circuit provides the heterodyning function for the meter. It uses vacuum tube V2B for mixing the lower frequencies (125 kc to 65 mc). The mixing efficiency of a vacuum tube decreases for high frequencies; therefore, when the meter RANGE SW. is at RANGE C, crystal diode CR2 functions as the mixer and V2B performs as an audio amplifier.

b. Low-Frequency Mixing. When the RANGE SW. is in RANGE A or RANGE B position, the output of the low-frequency vfo is applied to CR3, which functions as a harmonic generator. The harmonic output of CR3 is applied to the grid of mixer V2B through R5 (since the output of CR3 is positive, CR2 cannot conduct) and R10. The signal from the antenna is coupled through C36, CR1 (*c* below), R5, and R10 and applied to the grid of V2B. The incoming signal is mixed with the appropriate harmonic from the low-frequency vfo and the audio output from the mixer is coupled through C8 to the audio amplifier circuits.

c. High-Frequency Mixing. When the RANGE SW. is in the RANGE C position, the output of the high-frequency vfo is applied directly to CR2

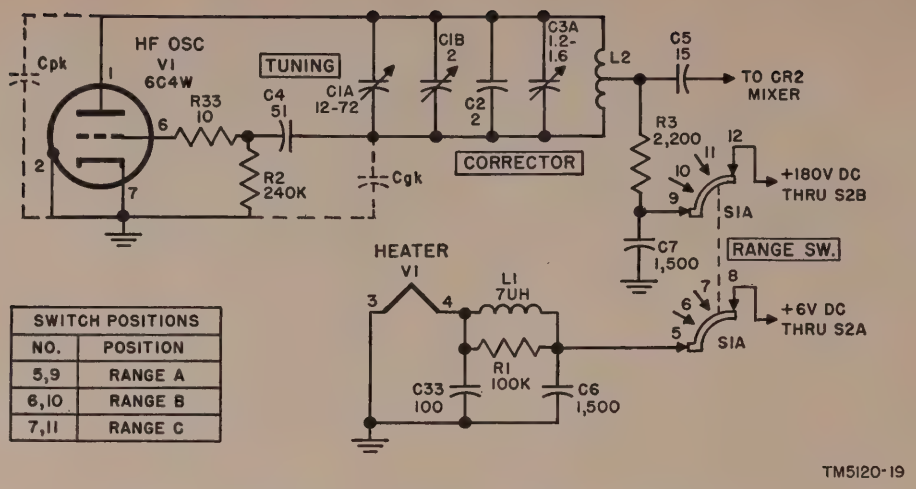


Figure 14. High-frequency oscillator, simplified schematic diagram.

FREQ METER AN/URM-32

and R5. Crystal CR2 conducts during negative portions of hf vfo output, therefore mixing occurs in CR2. The high-frequency oscillator has a strong harmonic output and a harmonic generator is not required. Crystal CR2 mixes the incoming signal from the antenna with the output from the high-frequency vfo and an audio frequency is developed across R9. Mixer V2B performs as an audio amplifier in this application and the audio signal is coupled through C8 to the audio amplifier circuits.

d. Crystal Oscillator Output. When the FUNCTION SW. is set to the CHK position, the output of the crystal oscillator is coupled through C34 to the cathode of V2B. In the RANGE A or RANGE B position, the output of the LF vfo is applied to the grid (pin 7) of V2B and mixing occurs in V2B. In the RANGE C position, the output of the HF vfo is applied to the grid (pin 7) of V2B and mixing occurs in V2B. Resistor R11 is the plate load for V2B and C9 bypasses the RF to ground. Resistor R10 is the parasitic suppressor and R34 and inductor L8 prevent undesirable oscillation at radom frequencies. Crystal CR1 serves as a harmonic generator and the output of either the low- or high-frequency oscillator is multiplied by CR1.

33. AF Amplifier and Modulator
(fig. 16)

a. The circuit shown in figure 16 combines the first audio amplifier, the second audio amplifier, and the audio oscillator and modulator circuits.

b. Stages V3A and V3B are used as the first and second audio amplifiers, respectively, in the OPER and CHK positions of FUNCTION SW. S2. In the OPER position of S2, the beat note produced by the external rf input signal and the vfo output is amplified and appears in the headset as an audible tone. In the CHK position of S2, the beat note produced by the crystal oscillator and vfo output is amplified and appears in the headset as an audible tone. The audio signal from the mixer stage is developed across grid resistor R16. It is amplified by V3A and coupled through C38 to the grid circuit of V3B. The audio output of V3B is coupled through capacitor C16 to the primary of output transformer T1. The induced secondary voltage appears across paralleled headset jacks J2 and J3. Resistors R17 and R20 are plate-load resistors for the two sections of V3. Capacitor C19 is the plate bypass.

c. The low-frequency oscillator on the high-frequency oscillator (depending upon the position of the RANGE SW.) is modulated with an audio frequency when FUNCTION SW. S2 is in the MOD position. In this position, the secondary of output transformer T1 is connected to the grid circuit of audio amplifier V3B through C17 and C15 (C17 is a blocking capacitor which prevents dc from flowing through the secondary of T1 in the OPER and CHK positions of S2). The stray capacitance between windings on the primary and secondary of T1 combine with their inductances to form a tuned-grid, tuned-plate oscillator for V3B. Feedback is accomplished through the interelectrode capacitance between plate and grid (Cgp). Capacitor C15 and resistor R19 provide grid-lead bias for the oscillator. The AF signal produced by this oscillator plate modulates the vfo (selected by S1A) by switching

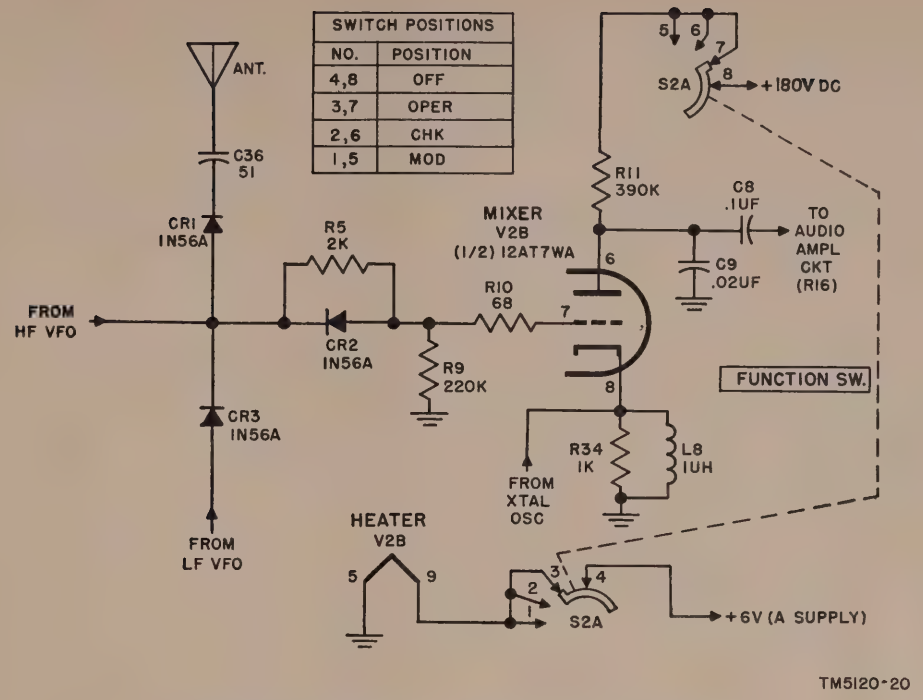


Figure 15. Mixer circuit, simplified schematic diagram.

the primary of T1 in series with the +180-volt dc source and the plate of the vfo. The combined impedance of T1 and R22 is equal to the load represented by R23, thus eliminating frequency shift in the vfo caused by changing load conditions. The modulated vfo output is coupled to ANT jack J1 through CR1 and C36 (fig. 24) and is available at this point for signal generator applications.

d. Heater current for V3A and V3B is available in all positions of S2 except OFF. In the OPER and CHK positions of S2, plate voltage is supplied to V3A through R17; in the MOD position, plate voltage is removed from V3A by switch S2B, thereby eliminating an undesired input to V3B when it functions as an oscillator. Plate voltage for V3B is applied through R21 and R20 in all positions of S2 except OFF. Capacitor C19 is the RF bypass capacitor for the power source and C16 prevents dc from flowing through the primary of T1 when S2 is in the OPER and CHK positions. Capacitor C18 bypasses RF around the power supply.

34. Voltage Regulator and Power Distribution Circuit

(fig. 17)

a. Plate voltage and heater current applications have been discussed for the various individual stages of the meter. The circuit shown in figure 17 provides the meter with the necessary voltage connections.

b. Power plugs P1, P2, and P3 may be connected to either dry batteries or a dc power supply; the only difference in application being that in the case of batteries, the cathode-heater current will be dc and with a power supply, the cathode-heater current will be ac. Also, terminals 3 and 7 on P3 connect to a section of FUNCTION SW. S2, which provides an ac power input on-off switch for the dc power supply when this unit is used; this switch section has no function when batteries are used. Switch S4 is the dc voltage interlock switch. Closing the frequency meter unit cover opens the switch and disconnects the B- and A- chassis-ground connection. VOLTAGE meter M1 is connected to VOLTAGE switch S3. With switch S3 in the A position, the meter indicates the condition of the A- voltage supply; green area good, red area bad. In the B position, the meter indicates the B- voltage supply in the same manner. POWER neon-glow lamp DS1 indicates that plate voltage is being applied to the electron tubes. Resistor R36 and capacitor C14, with DS1, form a relaxation oscillator circuit which causes neon-glow lamp DS1 to flash.

c. Tube V4 is connected as a voltage-regulator circuit. This circuit assures a constant-amplitude voltage for the plates of the oscillators, even with decreasing battery voltage or varying power supply voltage. In this manner frequency stability is improved.

d. The primary winding of output transformer T1 is switched in series with the vfo plate supply with S2 in the MOD position, providing plate modulation of these oscillators (pars. 30 and 31). The crystal oscillator plate and the first af amplifier plate are supplied +180 volts dc through S2; the oscillator plate is connected only when S2 is in the CHK position and the amplifier plate is connected when S2 is in the CHK and OPER positions (par. 33) but not in the MOD position.

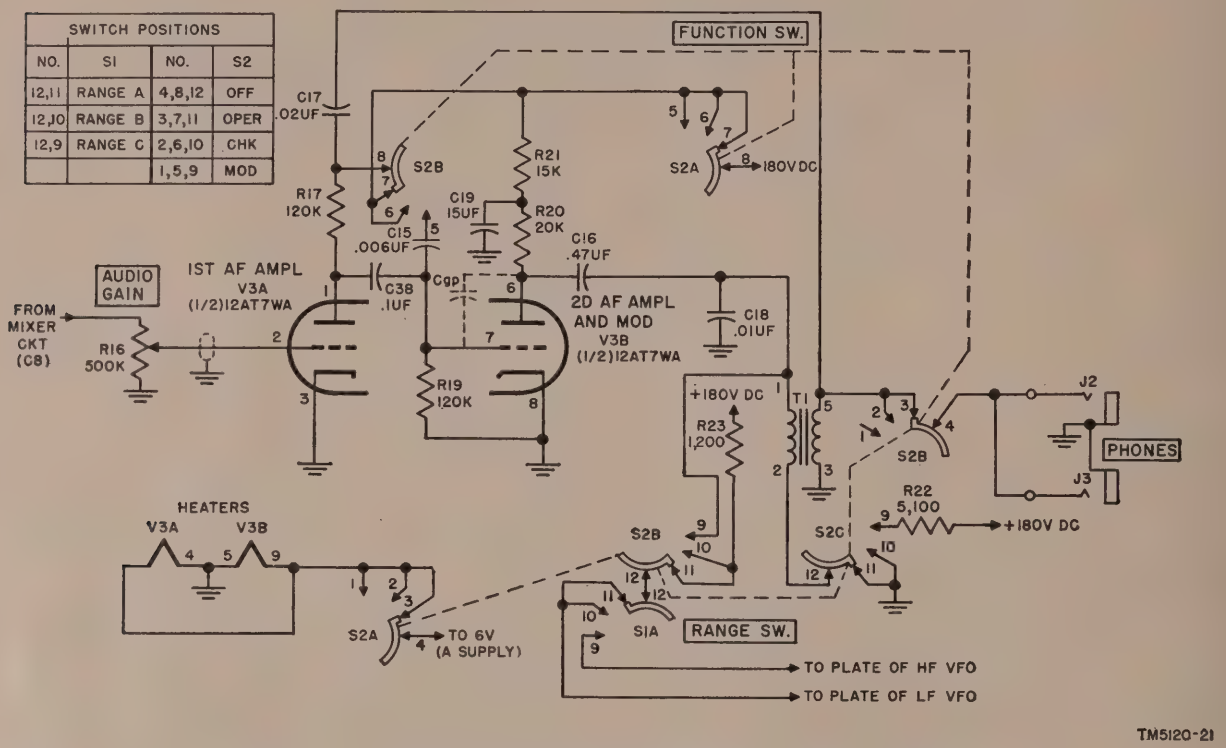


Figure 16. AF amplifier and modulator, simplified schematic diagram.

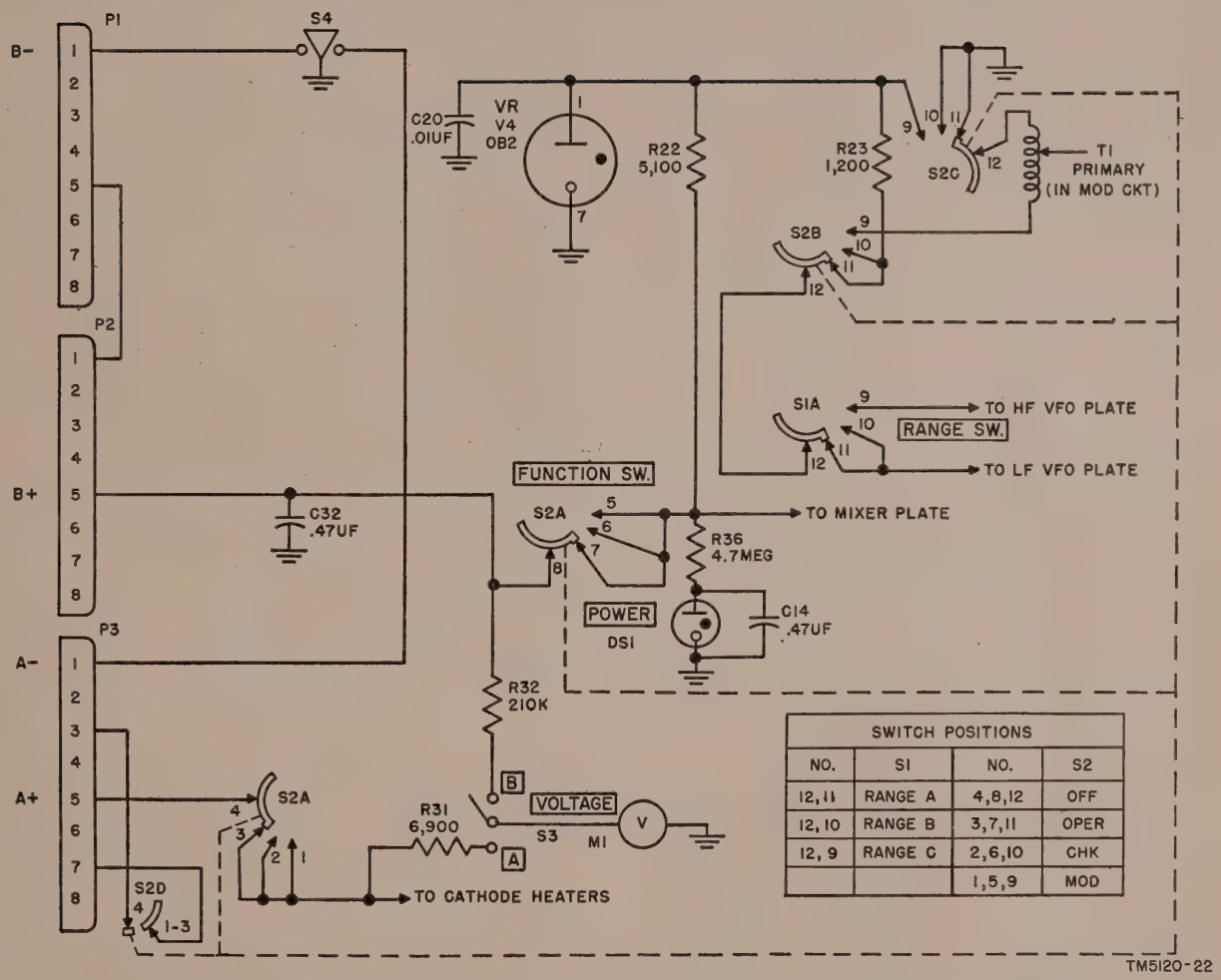


Figure 17. Voltage regulator and power distribution circuit, simplified schematic diagram.

FREQ METER AN/URM-32

CHAPTER 5

FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: Voltages above 175 volts exist in this equipment. Be very careful when handling or testing any part of the meter with power applied, after it has been removed from the case.

35. Troubleshooting Procedures

a. General. The first step in servicing a defective meter is to sectionalize the fault. Sectionalization means tracing the fault to a stage or circuit responsible for the abnormal operation of the meter. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers, often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltages and resistances.

b. Component Sectionalization and Localization. Listed below is a group of tets arranged to simplify and reduce unnecessary work and aid in tracing a trouble to a specific component. The simple tests are used first. Those that follow are more complex. Follow the procedure in the sequence given. A repairman must be careful to cause no further damage to the meter while it is being serviced. In general, the trouble is traced to a section or stage of the meter, and the faulty component in that section or stage is located; then the trouble is remedied.

(1) *Visual inspection.* Through visual inspection (par. 22) alone, the repairman may discover the trouble or determine the circuit in which the trouble exists. This inspection is valuable in avoiding additional damage to the meter which might occur through improper servicing methods and in forestalling future failures.

(2) *Determination of a faulty circuit.* Faulty operation may be caused by the failure of any of the following circuits:

(*a*) The variable-frequency oscillator.
(*b*) The crystal oscillator.
(*c*) The mixer.
(*d*) The audio amplifier.
(*e*) The modulator.
(*f*) The power source.

(3) *Sectionalization.* To find the circuit in which the trouble is located, make the following tests:

(*a*) To determine whether the crystal oscillator circuit has failed, turn FUNCTION SW. to CHK, and disable the vfo by removing electron tube V5. Couple the receiver (regenerative-type or one equipped with a beat oscillator) to the meter antenna and tune the receiver to 1,000 kc. A beat note heard in the receiver headset will indicate that the crystal oscillator is operating.

(*b*) To determine whether a variable-frequency oscillator has failed, put the meter into operation as for tuning a cw receiver to a desired frequency. Use a separate receiver (regenerative-type or one equipped with a beat oscillator) coupled to the meter antenna and tune both to the same frequency. Listen for a beat note with the receiver headset, while either the receiver or meter is tuned through the vicinity of the frequency selected. This will indicate that the selected vfo range is operating.

(4) *Alternate method.* An alternate method of

isolating a faulty circuit is as follows:

(*a*) Remove the meter chassis from the cabinet and connect it to the batteries.

(*b*) Set the FUNCTION SW. to the CHK position and allow the tubes to become warm. Advance the AUDIO GAIN control to its maximum clockwise position.

(*c*) Remove mixer tube V2 from the socket a few times. If a loud click is heard in the headset each time, the audio amplifier and the detector tube plate circuit are operating.

(*d*) Hold one end of a wire or screw driver in contact with the chassis. Touch the other end a few times in rapid succession to the connection of pin 2 of V2A. If a loud click is not heard in the headset each time, the wire makes or breaks contact, the crystal oscillator circuit is probably not operating.

(*e*) Hold one end of a wire or screw driver in contact with the chassis and touch the other end a few times in rapid succession to the lead connected to pin 7 of V5B for the low-frequency vfo and pin 6 of V1 for the high-frequency vfo. If a loud click is not heard in the headset each time, the wire makes or breaks contact with the lead, the selected variable-frequency oscillator circuit is probably not operating.

(5) *Localization procedures.*

(*a*) When one of the tests indicates the fault is within the crystal oscillator, variable-frequency oscillators, detector, or audio amplifier circuits, and if all simple tests have been made with no success, measure the various socket resistances and voltages. Use a 20,000 ohm-per-volt voltmeter. Use with a scale of at least 250 volts for B+ voltage measurements and a scale of at least 10 volts for A+ measurements; compare the measurement results with the values given in figure 21. The voltages may vary as much as 15 per cent from the listed values and still be satisfactory.

(*b*) When any test shows zero where a voltage should be present, trace the circuit with the aid of the appropriate schematic and wiring diagrams (figs. 24 and 25) until a point is reached where the voltage present agrees with the voltage specified.

(*c*) If a bypass capacitor is connected from the chassis to the point of zero voltage, first check across the capacitor with a continuity meter or ohmmeter. Turn off the power or disconnect batteries and discharge the capacitor before making this check. If the ohmmeter reading is nearly zero, the capacitor is shorted.

Caution: Before making any repairs to the variable-frequency oscillators, be sure that this is the cause of the trouble. Be careful when replacing parts in this section, because any change in position of wires and parts may affect the oscillator frequency.

(6) *Troubleshooting chart.* The trouble symptoms listed in this chart (par. 39) will aid greatly in localizing trouble.

(7) *Intermittents.* In all these tests, the possibility of intermittent conditions should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment, or increasing the surrounding temperature. It is possible that some external connection may cause the trouble. Test the wiring for loose connections and move the wires and components with an insulated tool, such as a pencil or fiber rod. This may show where a faulty connection or component is located.

36. Test Equipment Required for Troubleshooting

The items of test equipment required for troubleshooting the meter are listed below. Technical manuals associated with each item also are listed.

Test equipment	Technical manual	Common name
Audio Oscillator TS–382A/U.	TM 11–2684A	Audio oscillator
Electron Tube Test Set TV–7/U.	TM 11–5083	Tube tester
Multimeter ME–77/U	.....	Multimeter
RF Signal Generator AN/URM–25.	TM 11–5551	RF signal generator.
Voltmeter, Meter ME–30A/U.	.....	Voltmeter

37. General Precautions

Observe the following precautions carefully when servicing the meter:

a. Be careful when removing meter from the carrying case; dangerous voltages are exposed.

b. If the meter has been operating for some time, use a cloth when removing the metal tube shields and easily reached tubes. Use the tube puller (fig. 2) to remove the remotely located tubes 6C4W tube to prevent moving critical components.

c. Be careful when replacing parts in the high-frequency oscillator subchassis; any change in the position of wires and parts may affect the oscillator frequency.

d. Do not overtighten screws when assembling mechanical parts.

e. When changing a component that is held by screws, always replace the lockwashers.

38. Checking Filament and B+ Circuits for Shorts

a. After the B + line leaves the battery compartment, it is distributed by FUNCTION SW. S2. If the B + voltage is low for any position of the FUNCTION SW. or if there is no B + voltage, the trouble may be in the power supply circuit. This may be due to interlock switch S4 or the batteries (S4 connects B— to chassis-ground). When the defect which causes an abnormal B + voltage condition is in some other circuit, it probably will show up only in one position of the FUNCTION SW. Refer to the simplified diagram of power distribution to the meter (fig. 17) and the voltage and resistance measurements (fig. 21 and par. 40) for troubles checking resistances of transformers and coils.

b. A trouble in any circuit will be noticed when following the operating procedures (par. 15). These troubles will be indicated in the equipment performance checklist (par. 25). Normally, this procedure will sectionalize the trouble to one particular stage. Sometimes, if the B + circuit is shorted in the decoupling network of one stage, it may drop the voltage so that several stages are affected. Most of the checking can be accomplished from the bottom of the chassis.

39. Troubleshooting Chart

The following chart is supplied as an aid for locating troubles in the meter. It lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. The chart also indicates how to quickly localize trouble to the variable-frequency oscillators, crystal oscillator, mixer, audio amplifier, modulator or power supply circuits of the meter. After the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit ordinarily should be enough to isolate the defective parts. Normal voltage and resistance readings are given in figures 20 and 21 and paragraph 40.

Item	Indication	Probable trouble	Procedure
	Power cord connected to batteries and cover removed. POWER lamp does not flash.	Defective neon-glow lamp DS1. R36 open. C14 shorted.	Replace lamp. Replace R36. Replace C14.
	POWER lamp lights but VOLTAGE meter does not indicate.	Multiplier R32 open.	Replace R32.
	No beat note heard in any position of RANGE SW. S2. Unmodulated RF obtained at ANT jack.	Defective tube in AF amplifier and modulator circuit. Defective mixer tube. Faulty component in AF circuit.	Check V3 by substituion. Check V2 by substitution. Connect headset in series with .1-μf capacitor and check grid and plate circuits of V2 and V3; check by signal substitution (par. 42). Check voltages and resistances (par. 40 and fig. 21).
	Beat note not heard in CHK position of S2 or any position of RANGE SW. S1.	Faulty crystal oscillator stage.	Check V2 by substitution. Check voltage and resistances (par. 40 and fig. 21).
	Beat note heard in CHK position of S2, but not in OPER and MOD positions.	Not enough RF potential at ANT jack.	Use radio receiver to boost input (par. 15*e*).

Item	Indication	Probable trouble	Procedure
	Beat note heard in all positions of S2, but only in A and B positions of S1.	Faulty HF vfo stage.	Check V1 by substitution. Check voltage and resistances (par. 40 and fig. 21).
	Beat note heard in all positions of S2, but only in C position of S1.	Faulty LF vfo stage.	Check V5 by substitution. Check voltages and resistances (par. 40 and fig. 21).
	No beat note heard in any switch position. No output signal obtained at ANT jack.	Faulty B+ or filament circuit.	Determine faulty filament circuit with VOLTAGE switch S3 and VOLTAGE meter M1. Check faulty circuit as instructed in paragraph 38.

40. Dc Resistances of Transformers and Coils

The dc resistances of the transformers and coils in the meter are listed below:

Transformer or coil	Terminals	Ohms
T1	1–2	2,000
	3–4	15
	3–5	30
L1	.....	0
L2	.....	0
L3	.....	2.2
L4	.....	24
L5	.....	6.4
L6	Start to tap	.1
	Start to finish	.4
L7	Start to tap	8
	Start to finish	40
L8	.....	.5

41. Signal Substitution Notes

General notes on signal substitution and signal tracing are as follows:

a. A signal generator is required to develop the signal, of proper voltage and frequency, that is to be substituted in or traced through the equipment.

b. A method is required to observe, measure, or listen to the output of the circuit being tested. This may be by means of an oscilloscope to observe the wave form, a voltmeter to measure the voltage, or, under certain conditions, a loudspeaker or headset to listen to the signal.

Caution: Do not remove the shield cans or other shielding until the trouble has been traced to a particular unit. Do not push the wiring out of place. Pushing wiring back and forth may cause broken connections, change the frequency of an oscillator, or alter the characteristics of a circuit.

c. When connecting a signal generator to the grid of a tube, be sure that the low-impedance output of the signal generator does not short the grid voltage in the circuit under test. Connect a capacitor in series with the output (high side) of the signal generator.

d. The output impedance of the signal generator must be matched to the impedance of the circuit under test.

e. Once the signal is traced to a stage or circuit, disconnect the test equipment and make voltage and resistance measurements to locate the defective part.

42. Signal Substitution in Frequency Meter AN/URM–32

a. RF Signal Substitution. RF Signal Generator AN/URM–35 is required for the following tests. Refer to TM 11–5551, RF Signal Generator AN/URM–25, for operating instructions.

(1) Connect the output of the rf signal generator to the ANT jack on the front panel of the meter.

(2) Adjust the generator gain control to provide .1 volt signal.

(3) Set the RF signal generator output frequency to correspond to the dial setting on the meter. (Use the calibration book for determining this frequency.)

(4) Vary the main dial in the vicinity of the selected dial setting and listen for a beat note in the headset. If a beat note is heard, the fault lies in improper operating technique (par. 15).

(5) If a beat note cannot be obtained with the RF signal generator connected to the ANT jack, remove the meter chassis from the cabinet for further checking (par. 43).

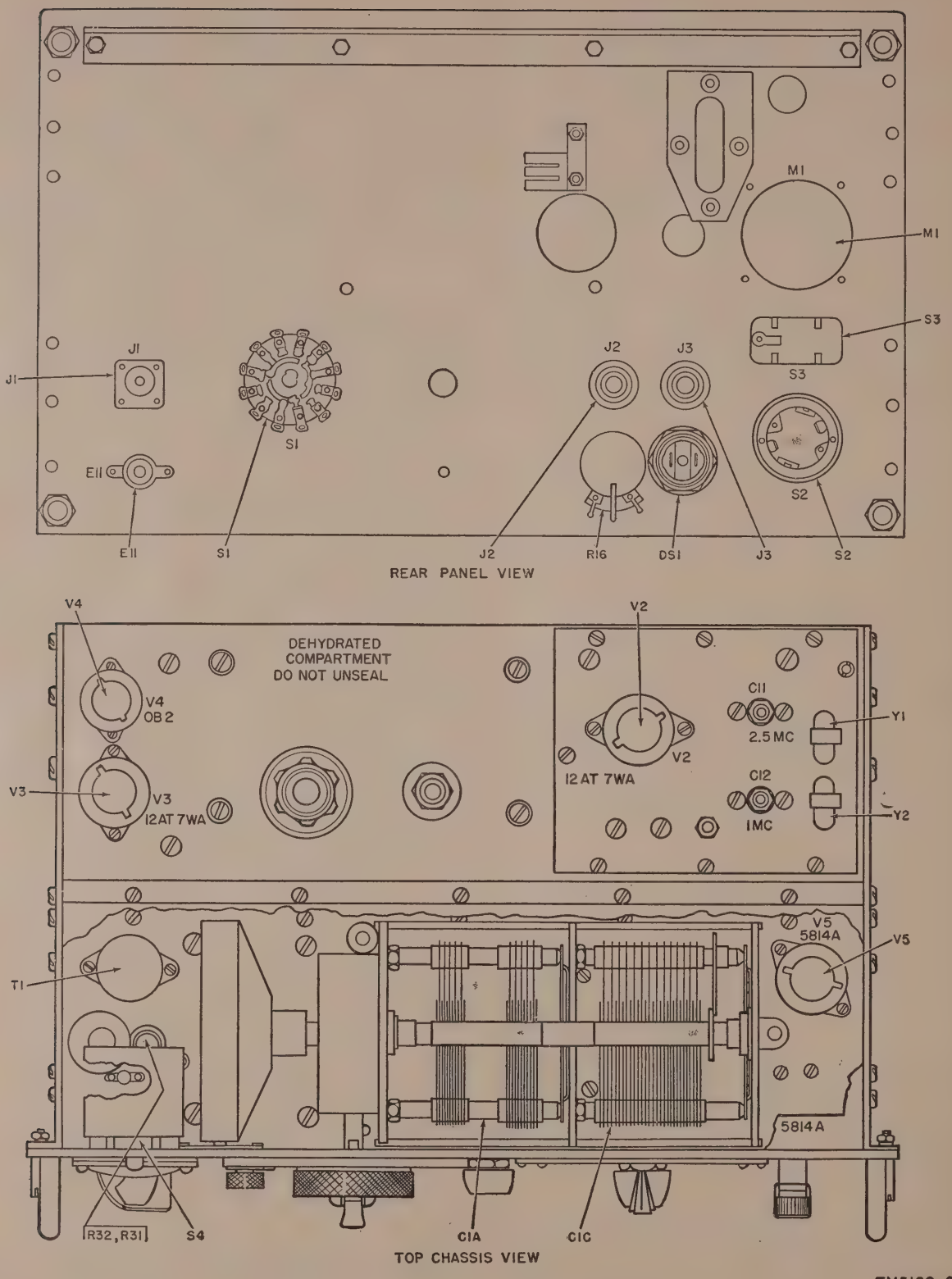


Figure 18. Meter, top view, location of parts.

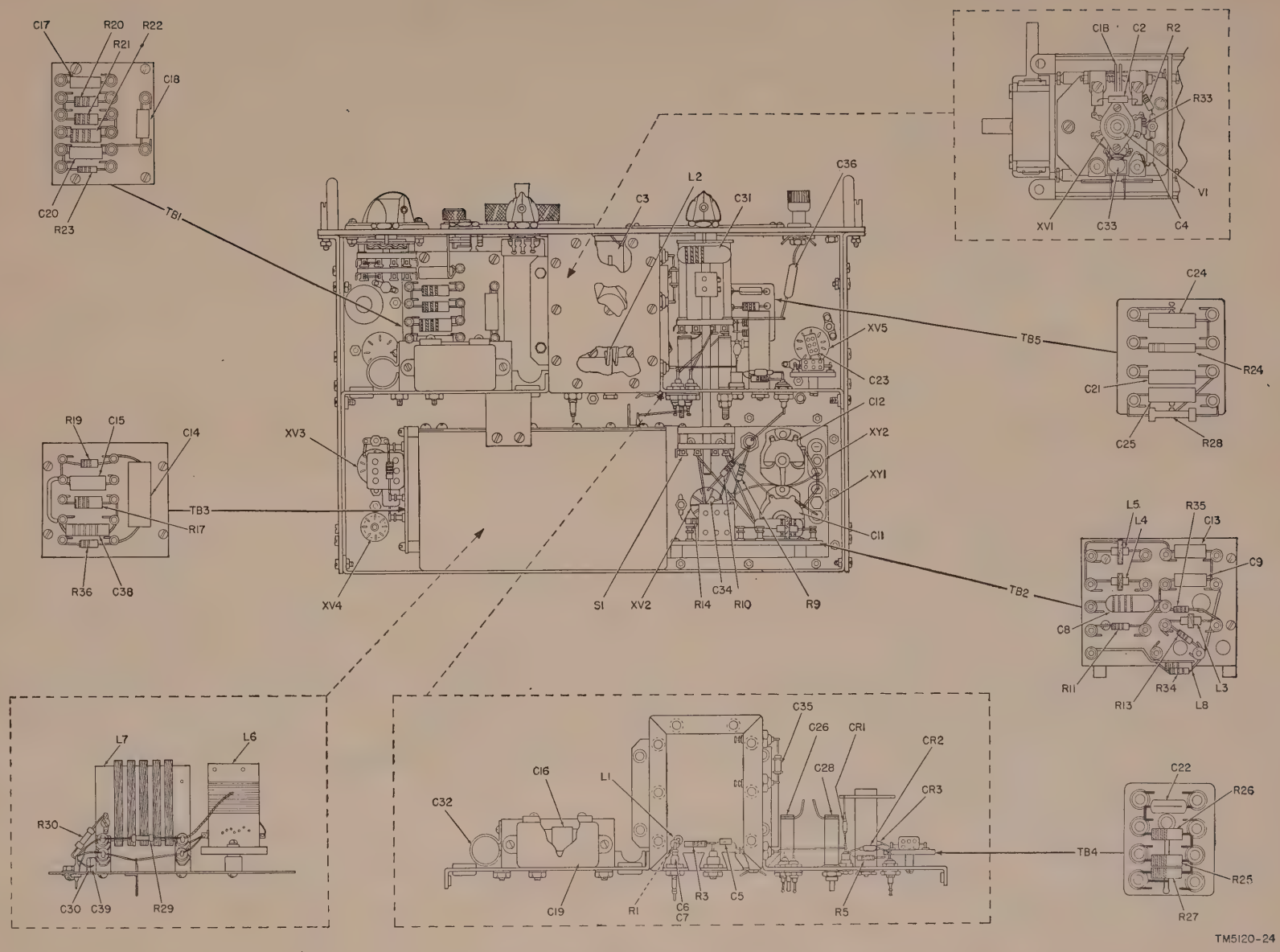


Figure 19. Meter, bottom view, location of parts.

FREQ METER AN/URM-32

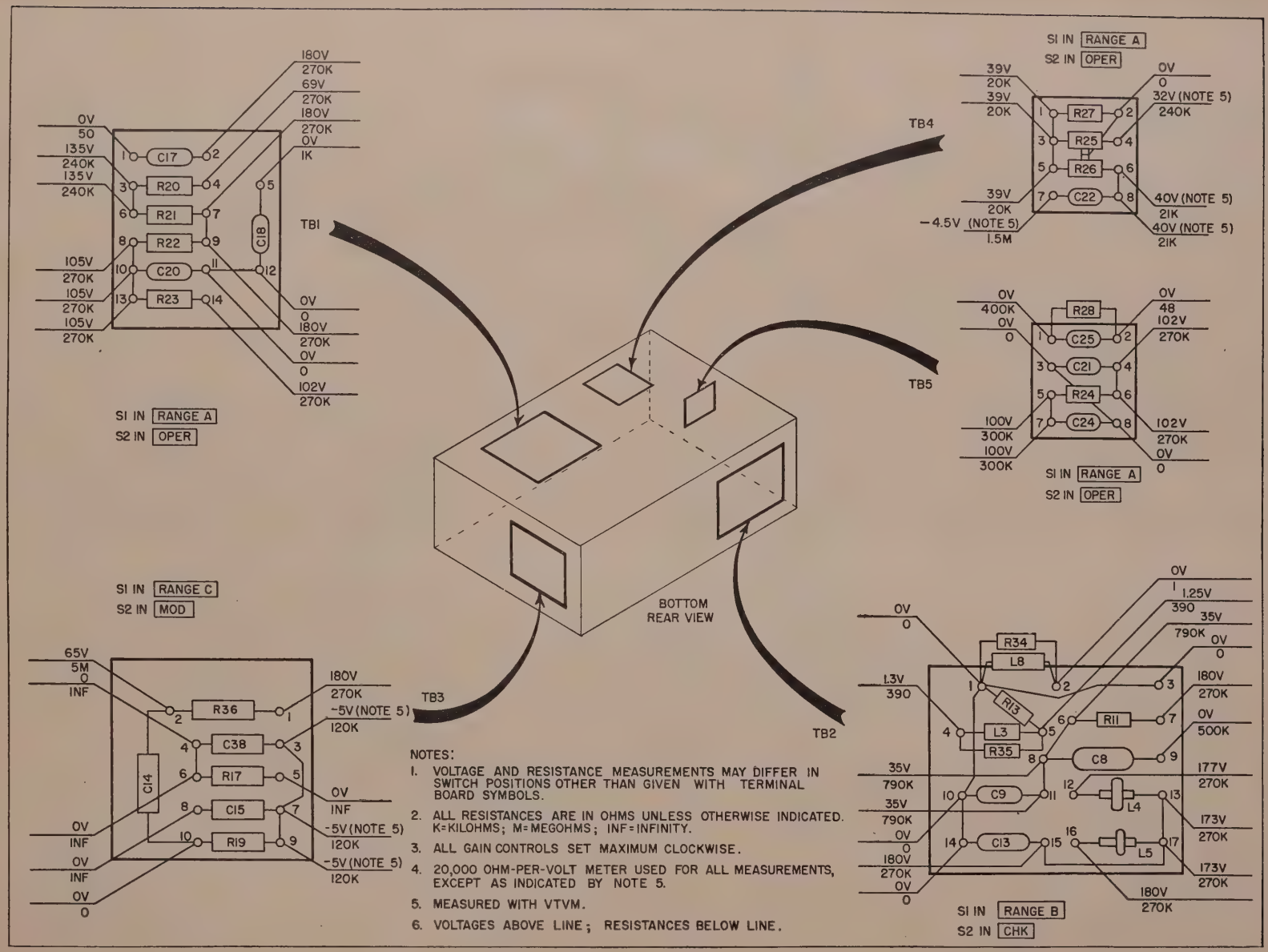

SI IN RANGE A
S2 IN OPER
TB1
TB2
TB3
TB4
TB5
BOTTOM
REAR VIEW
SI IN RANGE C
S2 IN MOD
SI IN RANGE B
S2 IN CHK
NOTES:
1. VOLTAGE AND RESISTANCE MEASUREMENTS MAY DIFFER IN SWITCH POSITIONS OTHER THAN GIVEN WITH TERMINAL BOARD SYMBOLS.
2. ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE INDICATED. K=KILOHMS; M=MEGOHMS; INF=INFINITY.
3. ALL GAIN CONTROLS SET MAXIMUM CLOCKWISE.
4. 20,000 OHM-PER-VOLT METER USED FOR ALL MEASUREMENTS, EXCEPT AS INDICATED BY NOTE 5.
5. MEASURED WITH VTVM.
6. VOLTAGES ABOVE LINE; RESISTANCES BELOW LINE.
TM5120-25

Figure 20. Terminal boards, voltage and resistance diagram.

FREQ METER AN/URM-32

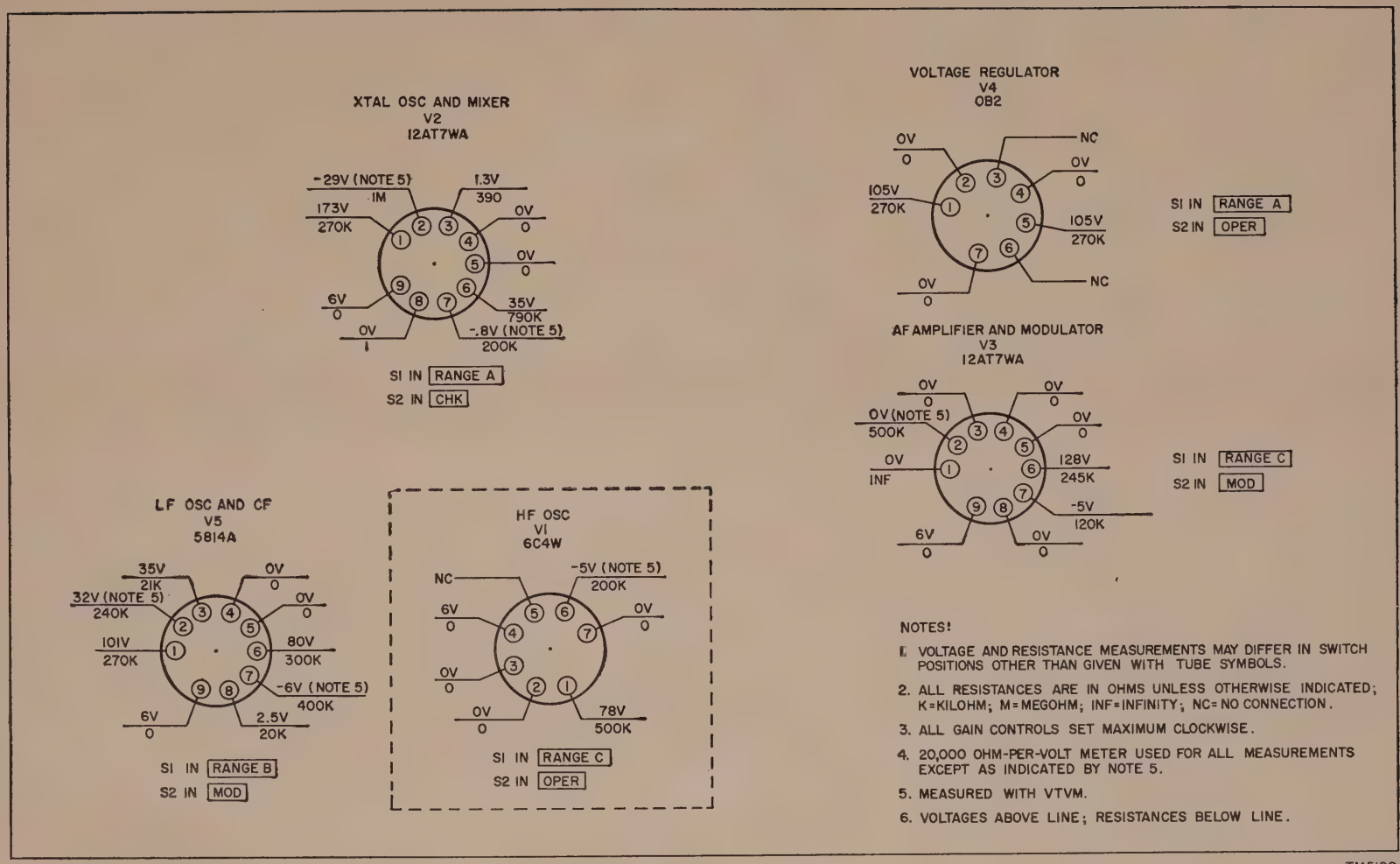


Figure 21. Tube sockets, voltage and resistance diagram.

(6) Isolate the defective part by moving the generator output connection, in successive steps, from the ANT jack to the grid of mixer tube V2B (figs. 24 and 25).

Note. In the preceding tests, it is assumed that satisfactory operation of the vfo covering the frequency being used for test purposes has been determined and that RANGE SW. S1 has been set to the correct position.

b. AF Signal Substitution. Audio Oscillator TS–382A/U is required for the following tests. Refer to TM 11–2684A, Audio Oscillator TS–382A/U, for operating instructions.

(1) Connect the audio oscillator output to the plate connection for mixer tube V2B and listen for an audio tone in the headset.

(2) If a beat note cannot be obtained at the plate of V2B, move the oscillator output connection to the grid of V3A; then to the plate of V3A, the grid of V3B, the plate of V3B, and finally to the primary side of output transformer T1. Each time the oscillator output connection is moved to a succeeding stage, the oscillator gain control must be increased correspondingly.

(3) When the defective stage has been isolated, use Electron Tube Test Set TV–7/U and check component parts and make voltage and resistance measurements (par. 40 and fig. 21).

(4) After repairs or replacements have been made, install the meter chassis in the cabinet and replace the cover (par. 11*a*).

Section II. REPAIRS

43. Replacement of Parts
(figs. 18 and 19)

Several parts in the meter have smaller tolerances than those used in most radio equipments. To replace these parts, use a part with the *exact* value of the part removed. If even slightly different values are used, the calibration of the meter output will be inaccurate.

a. The components of the meter can be reached and easily replaced if found faulty. The sockets, capacitors, etc. are mounted to the chassis with hexagonal nuts and pam-head screws. The dial knobs are removed with the Allen wrench provided with the meter.

b. If any of the switch wafers require replacement, carefully mark the wires connected to the wafer with tags to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires.

c. To remove the meter chassis from the cabinet, take out the four screws from the right and left sides of the front panel and slide the chassis straight out.

d. To reach the underside of the meter chassis, remove the seven screws that hold the bottom plate to the chassis and lift off the plate.

e. To reach the main tuning dial mechanism for repair or lubrication, take out the 19 screws that secure the top cover to the chassis and remove the cover.

f. For aid in determining values of resistors and capacitors, refer to the color codes (figs. 22 and 23).

g. To replace the tube in the high-frequency oscillator, remove the high-frequency oscillator subchassis top plate by taking out the ten retaining screws.

44. Meter Adjustments

The meter is a highly accurate instrument and no mechanical adjustment is necessary. Normally, electrical adjustment of the crystal oscillator circuit by means of trimmer capacitors is necessary during recalibration procedures (par. 46). Trimmer capacitors are also used in the vfo resonant circuits, but only for varying the total frequency range. Recalibration over the entire dial may be required if replacement of critical parts is necessary in these circuits (par. 46).

Caution: Do not unseal the dehydrated crystal oscillator compartment.

45. Test Equipment Required for Calibration and Alinement

Frequency Calibrator Set AN/URM–18 (referred to as Calibrator Set) is required for calibration and alinement of the meter. Refer to TM 11–2665 (Frequency Calibrator Set AN/URM–18) for operation instructions.

46. Calibration of Frequency Meter AN/URM–32

a. Calibration of Crystal Oscillator. Occasionally, the fundamental resonant frequency of the crystal oscillator will drift due to component part aging or replacement of the crystal. To calibrate and aline the crystal circuits properly, follow the procedures below in the sequence given—

(1) Remove the meter chassis from the cabinet and the bottom plate from the chassis (par. 43).

(2) Connect the input of the calibrator set, depending upon the range of the crystal being calibrated, between the ANT connector and chassis ground.

(3) Place the RANGE SW. in the range position corresponding to the crystal being calibrated.

(4) Place the FUNCTION SW. in the CHK position.

(5) Use the main dial to detune the vfo and prevent possible interaction between the vfo and the internal crystal.

(6) Set the calibrator set to the resonant frequency of the crystal being calibrated (1 mc or 2.5 mc).

(7) Trimmer capacitors C11 and C12 are connected in parallel with crystals Y1 and Y2, respectively. Adjust trimmer capacitor C11 or C12 (fig. 10), depending on the crystal being calibrated, until the calibrator set indicates that the RF output from the cathode of the crystal oscillator is correct.

(8) Tighten the locking nuts on the trimmer capacitors to prevent changes caused by vibration.

(9) Reinstall the bottom plate on the chassis and return the chassis to the cabinet (par. 43).

b. Calibration of Variable-Frequency Oscillator. To recalibrate a variable-frequency oscillator, a new calibration book must be requisitioned. The replacement calibration book is essentially the same as the book supplied with the meter, except that the columns in the book titled DIAL are blank. If the low-frequency variable oscillator requires recalibration, dial settings for all fundamental frequencies in ranges A and B may be necessary. If the high-frequency variable oscillator requires calibration, only the dial settings for the fundamental frequencies in range C are necessary. To properly calibrate and aline the variable-frequency oscillator circuits, proceed as follows:

(1) Connect the input of the calibrator set, depending on the range of the vfo to be calibrated, to the ANT jack on the front panel of the meter.

(2) Place the RANGE SW. of the meter in the range position corresponding to the vfo being calibrated.

(3) Place the FUNCTION SW. of the meter in the OPER position.

(4) Set calibrator set to the low and high extremes of the frequency range being calibrated and use the CORRECTOR control of the meter to determine if the frequency range of the vfo is within this band. If the vfo range is not within the band, remove the meter chassis from the cabinet to reach the trimmer capacitors (par. 43). Capacitor C1B is the trimmer for range C and is adjusted by inserting an alinement tool through the access hole in the right side plate. Capacitors C26 and C28 are trimmers for range A and range B, respectively; these trimmers are adjusted by inserting an alinement tool through the access holes in the rear of the chassis (fig. 10). Adjust the trimmer capacitors ((*a*) through (*i*) below) until the vfo output is within the correct range when the main dial of the meter is swung to the extreme positions. Reinstall the meter chassis in the cabinet, and proceed as follows:

(*a*) Set the main dial of the meter at 4,700; set the calibrator set to the upper frequency limit of the range being calibrated.

(*b*) Turn the CORRECTOR control of the meter until a minimum frequency reading is obtained on the calibrator set. Record this frequency. Turn the CORRECTOR control of the meter in the opposite direction until a maximum frequency reading is obtained on the calibrator set. Record this setting of the CORRECTOR control.

(*c*) Subtract the lesser reading from the greater, divide the difference by two, and add the quotient to the lesser reading. This is the midpoint frequency for the CORRECTOR control.

(*d*) Set the calibrator set to the midpoint frequency, and vary the CORRECTOR control of the meter until it is at this frequency.

(*e*) Set the calibrator set to the lower limit of the frequency range. Turn the main dial of the meter to the low end (around 200) until the calibrator set indicates that the output of the vfo is at the low-frequency point for the particular frequency range being calibrated.

(*f*) Use an alinement tool and adjust the proper trimmer capacitor (C26, range A; C28, range B; C1B, range C) and slowly rotate the main dial of the meter until the low-frequency point is as close as possible to the 200-division on the main dial.

(*g*) Adjust calibrator set to the high end of the frequency range, and rotate the main dial of the meter until the calibrator set indicates the vfo output to be at this frequency. Set the main dial to approximately 4,700 divisions.

(*h*) If adjustment of the trimmer capacitor has caused the high-frequency point to be off dial, readjust this component to a value that will bring the high-frequency point back on the dial approximately the same number of divisions away from 4,700 as the low-frequency point is from 200. It may be necessary to check and adjust at both ends of the range several times before this condition can be obtained.

(*i*) After the trimmer capacitor adjustments have been made, reinstall the meter chassis in the cabinet and proceed with the following calibration procedures.

Note. Do not disturb the CORRECTOR control setting when returning the meter chassis to the cabinet. Do not change the setting of this control until after calibration has been completed.

(5) Open the replacement calibration book to the first frequency calibration page for the frequency range being calibrated.

(6) Set the calibrator set to the low-frequency point for this range.

(7) Turn the main dial of the meter toward the low end until the calibrator set indicates that the low-frequency point has been reached.

(8) Record the reading of the main dial in the column titled DIAL opposite the first line of frequencies (fundamental and harmonics).

(9) Set the calibrator set to the second successive fundamental frequency listed in the calibration book and rotate the main dial of the meter until the calibrator set indicates the output of the vfo to be at this frequency.

(10) Record the reading of the main dial in the column titled DIAL opposite the second line of frequencies.

(11) Repeat the calibration procedure for each fundamental frequency listed in the book for the frequency range being calibrated; record each dial setting obtained in its proper place. Also, transcribe the crystal check point dial settings at the bottom of each page.

(12) Disconnect the calibrator set and replace the cover for the meter.

Section IV. FINAL TESTING

47. General

Paragraphs 48 through 52 are intended as a guide to be used in determining the quality of a repaired meter. The minimum test requirements outlined in these paragraphs may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

48. Test Equipment Required for Final Testing

In addition to the test equipment listed in paragraphs 36 and 45, Radio Receiver R–220/URR (referred to as receiver) is required for final testing. Refer to TM 11–882 for instructions on how to use the receiver.

49. Audio Power Output with External RF Input

a. Prepare the meter as instructed for normal operation (par. 13).

b. Couple the output of the RF signal generator to the ANT jack on the meter front panel.

c. Adjust the rf signal generator gain for a .1-volt output.

d. Place the meter FUNCTION SW. in the OPER position and the RANGE SW. in the RANGE A position.

e. Set the RF signal generator frequency control and the main dial of the meter at a crystal check point frequency.

f. Plug the headset into the alternate PHONES jack of the meter and vary the CORRECTOR control until an approximate 500-cps beat tone is heard.

g. Remove the headset from the PHONES jack and connect a 600-ohm (½-watt) resistor in its place.

h. Connect the voltmeter across the 600-ohm resistor and vary the CORRECTOR control until maximum reading is obtained on the voltmeter; minimum acceptable auido power output is 1 milliwatt (approximately .775 volt).

i. Repeat the procedures listed above for RANGE B and RANGE C positions of the RANGE SW.

j. Disconnect the RF signal generator and proceed with the test described in paragraph 50.

50. Audio Power Output with Internal Crystal Oscillator RF Input

a. After disconnecting the RF signal generator, return the RANGE SW. to the RANGE A position.

b. Place the FUNCTION SW. in the CHK position.

c. Obtain the dial setting for the crystal check point at the lower limit of range A from the calibration book, and rotate the main dial to this setting.

d. Vary the CORRECTOR control until maximum reading is obtained on the voltmeter; minimum acceptable audio power output is .5 milliwatt.

e. Repeat the test procedures in *a* through *d* above for all crystal check points in range A; then turn the RANGE SW. to the RANGE B position and repeat the tests for this range; finally, turn the RANGE SW. to the RANGE C position and check this range in a similar manner.

f. Disconnect the voltmeter and 600-ohm test resistor and proceed with the test in paragraph 51.

51. RF Output

a. Connect a 50-ohm (½ watt resistor) between the antenna input and ground on the receiver. Feed the modulated RF output from the ANT jack on the meter into the receiver antenna input.

b. Adjust the RF gain of the receiver to give a midscale indication on the receiver meter. Record the exact meter reading. Do *not* disturb the receiver RF gain control setting.

c. Disconnect the meter and connect the modulated RF output from the RF signal generator, which has a calibrated output attenuator, to the receiver antenna input.

d. Without moving the receiver RF gain control setting, adjust the RF signal generator attenuator to produce exactly the same midscale deflection on the receiver meter as recorded in *b* above. The reading on the rf signal generator calibrated attenuator equals the RF output of the meter; minimum acceptable RF output is 100 microvolts.

e. Disconnect the RF signal generator and resistor and proceed with the test in paragraph 52.

52. Calibration Accuracy

a. After disconnecting the test equipment (par. 51*e*), connect the calibrator set to the ANT jack on the meter front panel.

b. On the meter, set the RANGE SW. in the RANGE A position.

c. Obtain the dial setting for the crystal check point at the lower limit of range A from the calibration book, and rotate the main dial of the meter to this setting.

d. On the meter, turn the FUNCTION SW. to the CHK position, connect the headset to the PHONES jack, and vary the CORRECTOR control until a zero beat is heard.

e. On the meter, turn the FUNCTION SW. to the OPER position. Set meter hundreds drum and main dial to the lowest calibrated frequency within that crystal check range.

f. Vary the setting of the calibrator set until the exact output frequency of the meter vfo is indicated. Compare the indicated frequency with the published frequency; maximum acceptable frequency deviation is .01 percent. Then set meter hundreds drum and main dial to the highest calibrated frequency within the same crystal check range. Measure the frequency of the meter with the calibrator set. Compare the indicated frequency with the published frequency, maximum acceptable frequency deviation is .01 percent.

g. Repeat the procedures in *a* through *f* above for all crystal check points in range A, range B, and range C.

h. Disconnect the calibrator set and the headset. Return the headset to its holder in the front cover and install the cover on the meter.

i. When calibration accuracy is not within specified tolerance, refer to the recalibration procedures in paragraph 46.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

53. Disassembly

The following instructions are recommended as a general guide for preparing the meter for transportation and storage.

a. Disconnect and remove the batteries from the battery compartment (par. 11). Temporarily fasten the power cable connectors to the cabinet with strips of waterproof, pressure-sensitive tape.

b. Lock the main dial.

c. Remove the headset, antenna, and cables and place them in their holders in the cover.

d. Install the cover on the cabinet and secure it with the four latch fasteners.

54. Repackaging for Shipment or Limited Storage

Figure 3 illustrates a typical method of repackaging the equipment. Specific directions for repackaging the meter are as follows:

a. Packaging.

(1) Cushion the meter on all surfaces with cells or pads fabricated of corrugated fiberboard. Place the cushioned meter, together with technical manuals and desiccant, within a close-fitting, slotted, corrugated fiberboard box. Seal the entire closure with gummed tape and blunt all corners of the box.

(2) Place the boxed meter within a moisture-vaporproof barrier, and heat-seal the closure. Place the moisture-vaporproof meter, with the manuals, within a second close-fitting, slotted, corrugated fiberboard box and seal the entire closure with water-resistant tape or adhesive.

(3) Overwrap the boxed meter in waterproof barrier material. In accordance with approved specifications, completely seal all joints, seams, and closures with adhesive or other suitable seal equal in moisture resistance to that of the body material.

b. Packing.

(1) Place the equipment, packaged as described above, within a nailed wooden box lined inside with a 2-inch thickness of excelsior compacted to 3 pounds per cubic foot. The shipping container should *not* be lined with a waterproof bag.

(2) For oversea shipment only, the shipping container should be strapped in accordance with approved specifications.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

55. General

Demolition procedures outlined in paragraph 56 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

56. Methods of Destruction

Use the following methods to destroy the equipment:

a. Smash. Smash the controls, tubes, crystals, coils, switches, capacitors, transformers, and meter;

use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. *Cut.* Cut the output and power cord and slash the RF shield; use axes, handaxes, or machetes.

c. *Burn.* Burn cords and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

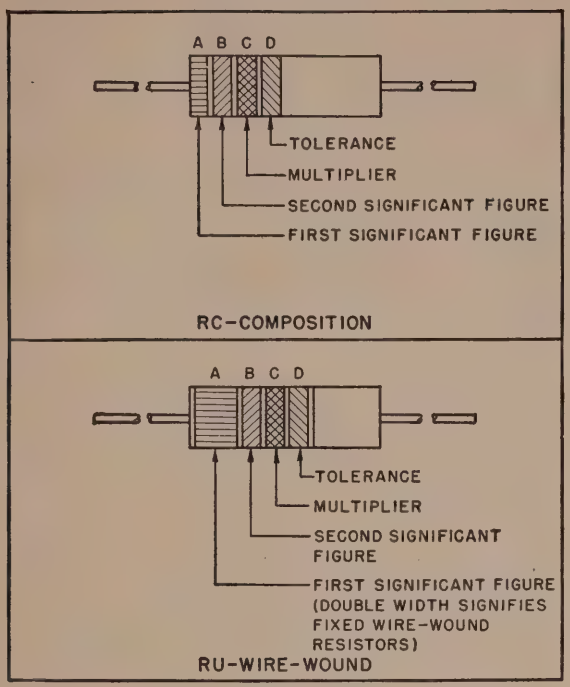
d. *Bend.* Bend panel and cabinet.

e. *Explode.* If explosives are necessary, use firearms, grenades, or TNT.

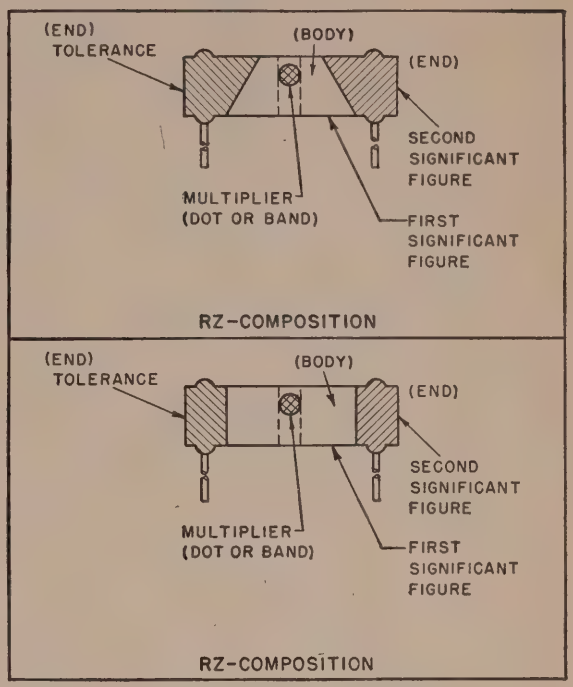
f. *Dispose.* Bury or scatter the destroyed parts in slit trenches or foxholes, or throw them into streams.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

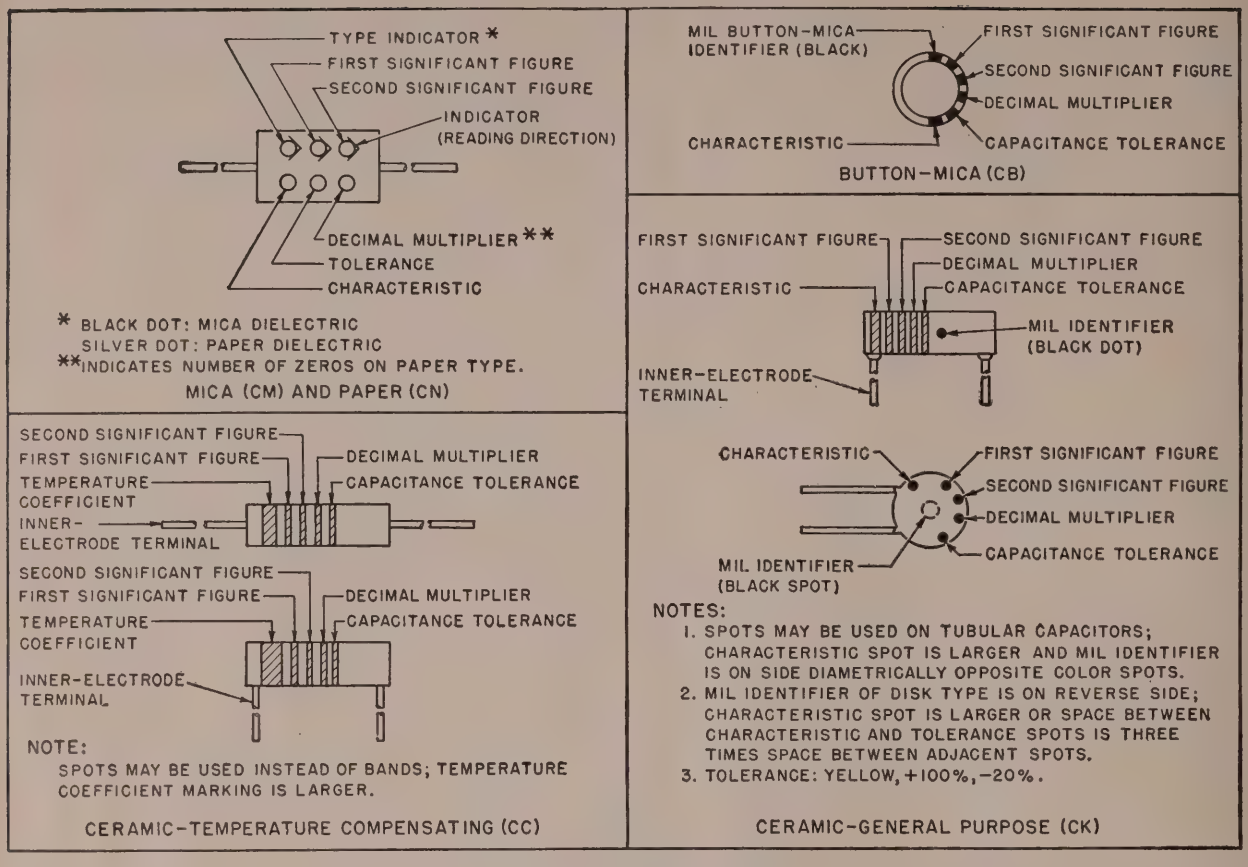
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

Figure 22. MIL-STD resistor color codes.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



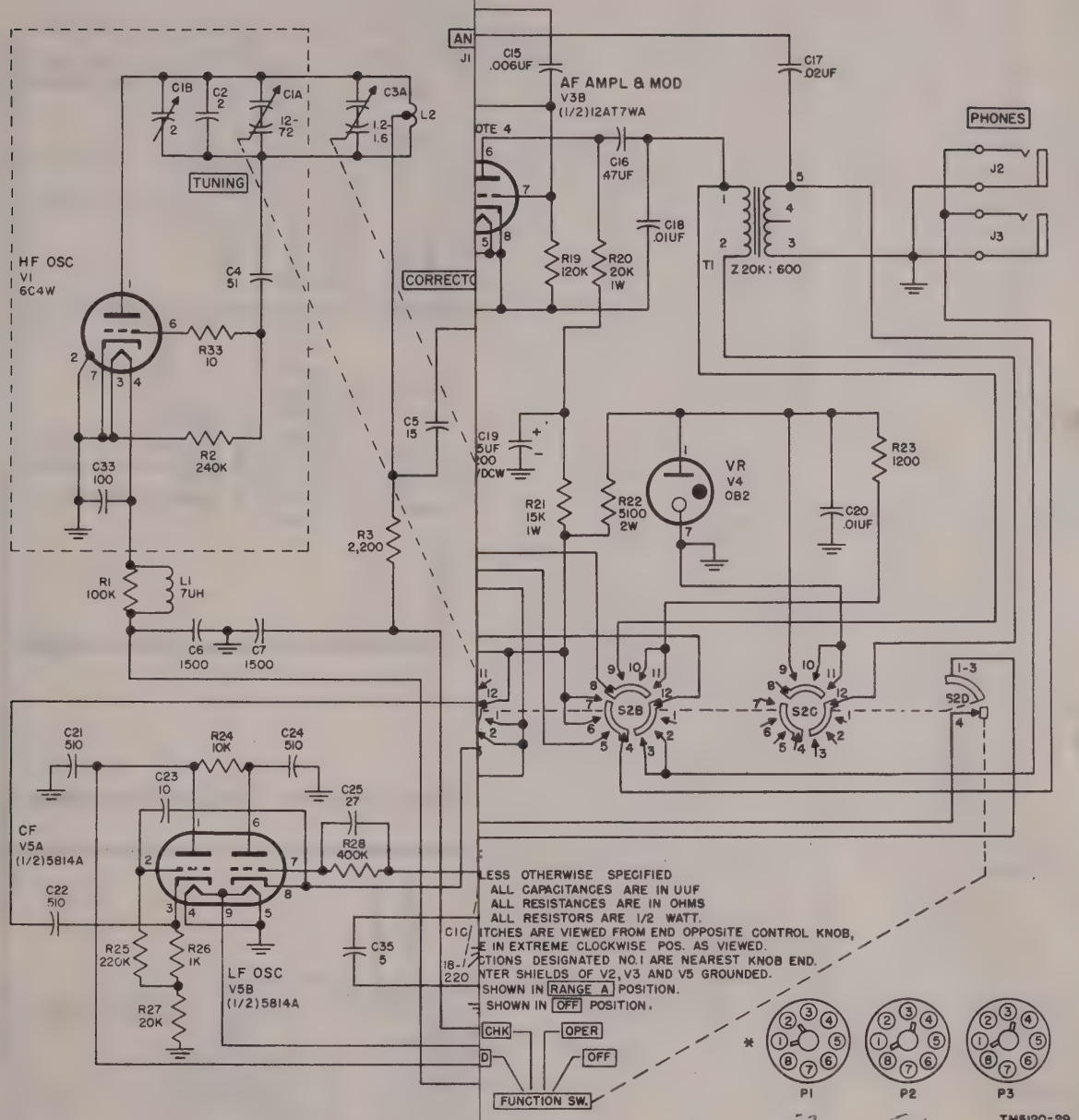
CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

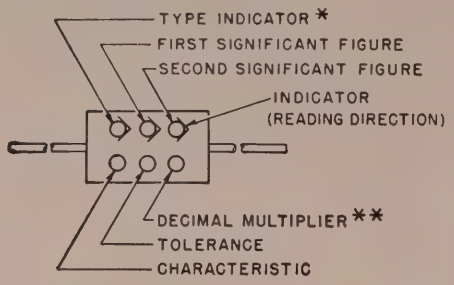
1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 23. MIL-STD capacitor color codes.

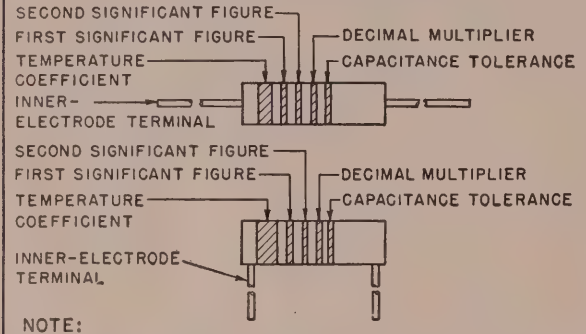

AN
J1
C15
.006UF
AF AMPL & MOD
V3B
(1/2)12AT7WA
C17
.02UF
PHONES
J2
J3
C16
47UF
C18
.01UF
R19
120K
R20
20K
1W
T1
Z 20K : 600
C1B
2
C2
2
C1A
12-
72
C3A
1.2-
1.6
L2
TUNING
HF OSC
V1
6C4W
C4
51
R33
10
R2
240K
C33
100
CORRECTO
C5
15
C19
5UF
00
/DCW
R21
15K
1W
R22
5100
2W
VR
V4
0B2
R23
1200
C20
.01UF
R3
2,200
R1
100K
L1
7UH
C6
1500
C7
1500
S2B
S2C
S2D
1-3
C21
510
R24
10K
C24
510
C23
10
C25
27
CF
V5A
(1/2)5814A
R28
400K
C22
510
R25
220K
R26
1K
R27
20K
LF OSC
V5B
(1/2)5814A
C35
5
LESS OTHERWISE SPECIFIED
ALL CAPACITANCES ARE IN UUF
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/2 WATT.
ITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB,
E IN EXTREME CLOCKWISE POS. AS VIEWED.
CTIONS DESIGNATED NO.1 ARE NEAREST KNOB END.
NTER SHIELDS OF V2, V3 AND V5 GROUNDED.
SHOWN IN RANGE A POSITION.
SHOWN IN OFF POSITION.
CHK
OPER
OFF
FUNCTION SW.
P1
P2
P3
J3
J4
TM5120-29

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



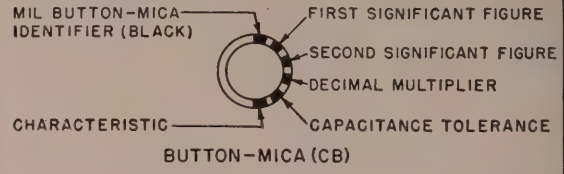
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

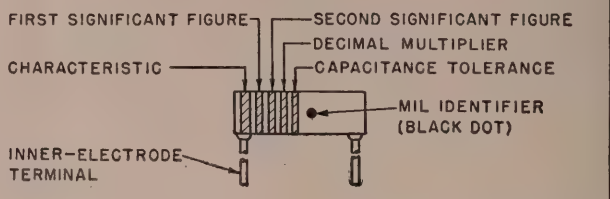


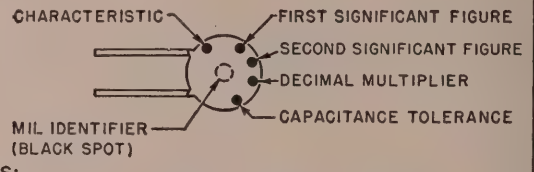
NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



BUTTON-MICA (CB)





NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

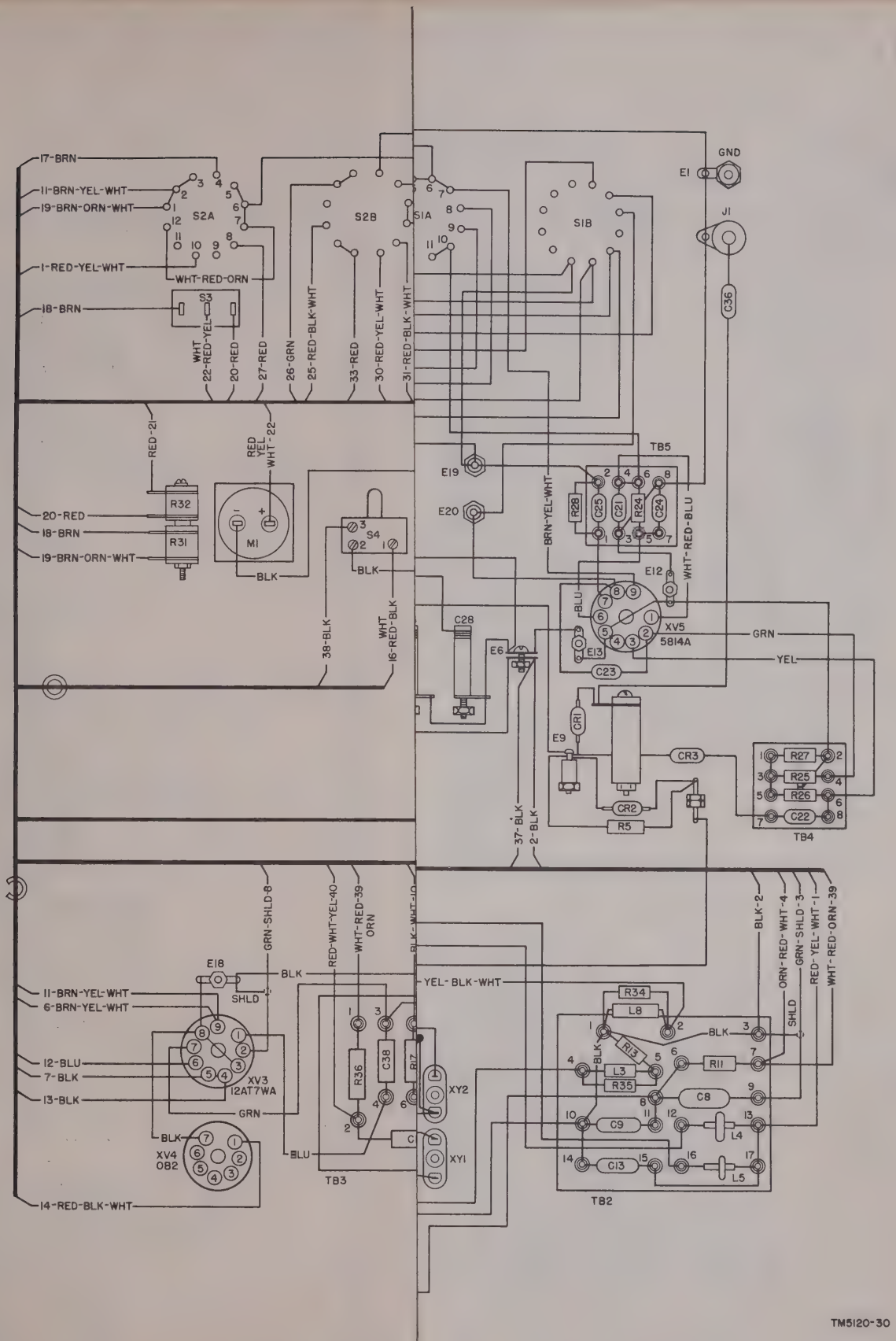
COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330($\pm$500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

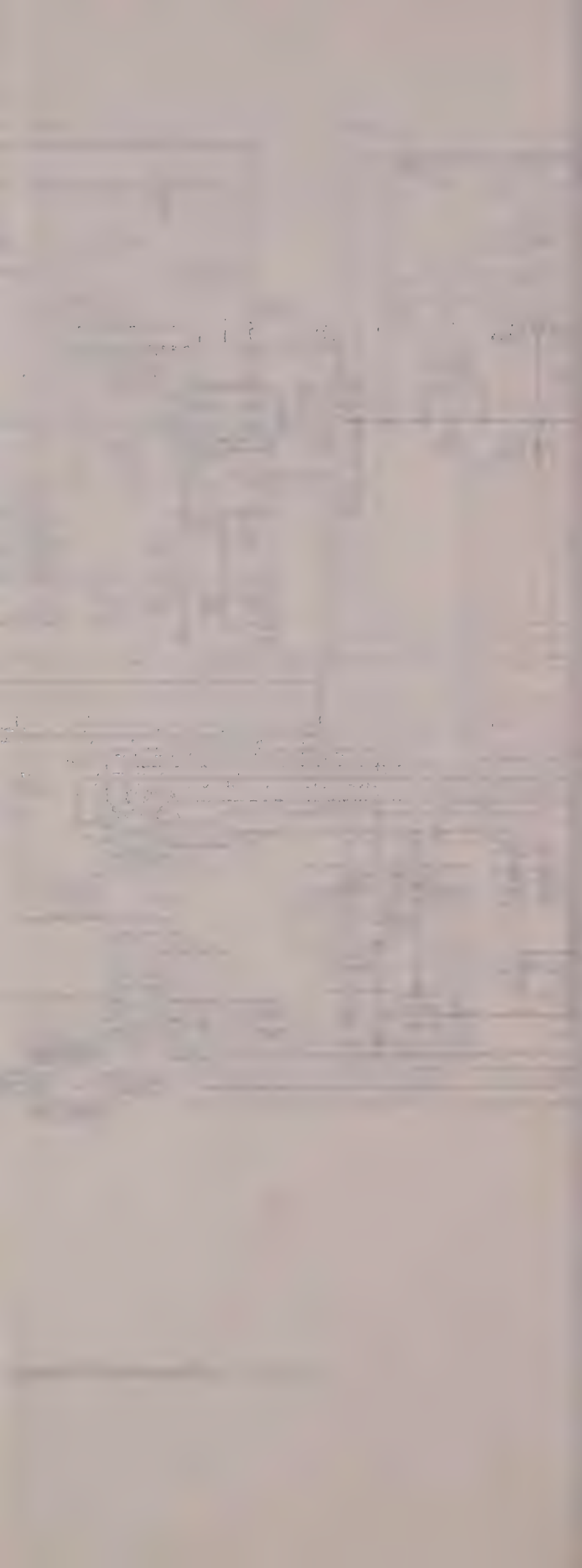
STD-CI

Figure 23. MIL-STD capacitor color codes.

Figure 24. Frequency Meter AN/URM-32, schematic diagram.


17-BRN
11-BRN-YEL-WHT
19-BRN-ORN-WHT
1-RED-YEL-WHT
WHT-RED-ORN
18-BRN
S2A
S2B
S1A
S1B
S3
WHT
22-RED-YEL
20-RED
27-RED
26-GRN
25-RED-BLK-WHT
33-RED
30-RED-YEL-WHT
31-RED-BLK-WHT
GND
E1
J1
C36
RED-21
RED
YEL
WHT-22
R32
R31
M1
20-RED
18-BRN
19-BRN-ORN-WHT
BLK
S4
38-BLK
WHT
16-RED-BLK
E19
E20
TB5
BRN-YEL-WHT
R28
C25
C21
R24
C24
WHT-RED-BLU
E12
BLU
XV5
5814A
E13
C23
GRN
YEL
C28
E6
E9
CR1
CR3
CR2
R5
R27
R25
R26
C22
TB4
37-BLK
2-BLK
GRN-SHLD-8
RED-WHT-YEL-40
WHT-RED-39
ORN
BLK-WHT-10
BLK-2
ORN-RED-WHT-4
GRN-SHLD-3
RED-YEL-WHT-1
WHT-RED-ORN-39
E18
SHLD
BLK
YEL-BLK-WHT
11-BRN-YEL-WHT
6-BRN-YEL-WHT
12-BLU
7-BLK
13-BLK
GRN
XV3
12AT7WA
XV4
082
BLK
BLU
14-RED-BLK-WHT
R36
C38
R17
XY2
C
XY1
TB3
R34
L8
R13
L3
R35
R11
C8
C9
L4
C13
L5
TB2
SHLD

TM5120-30



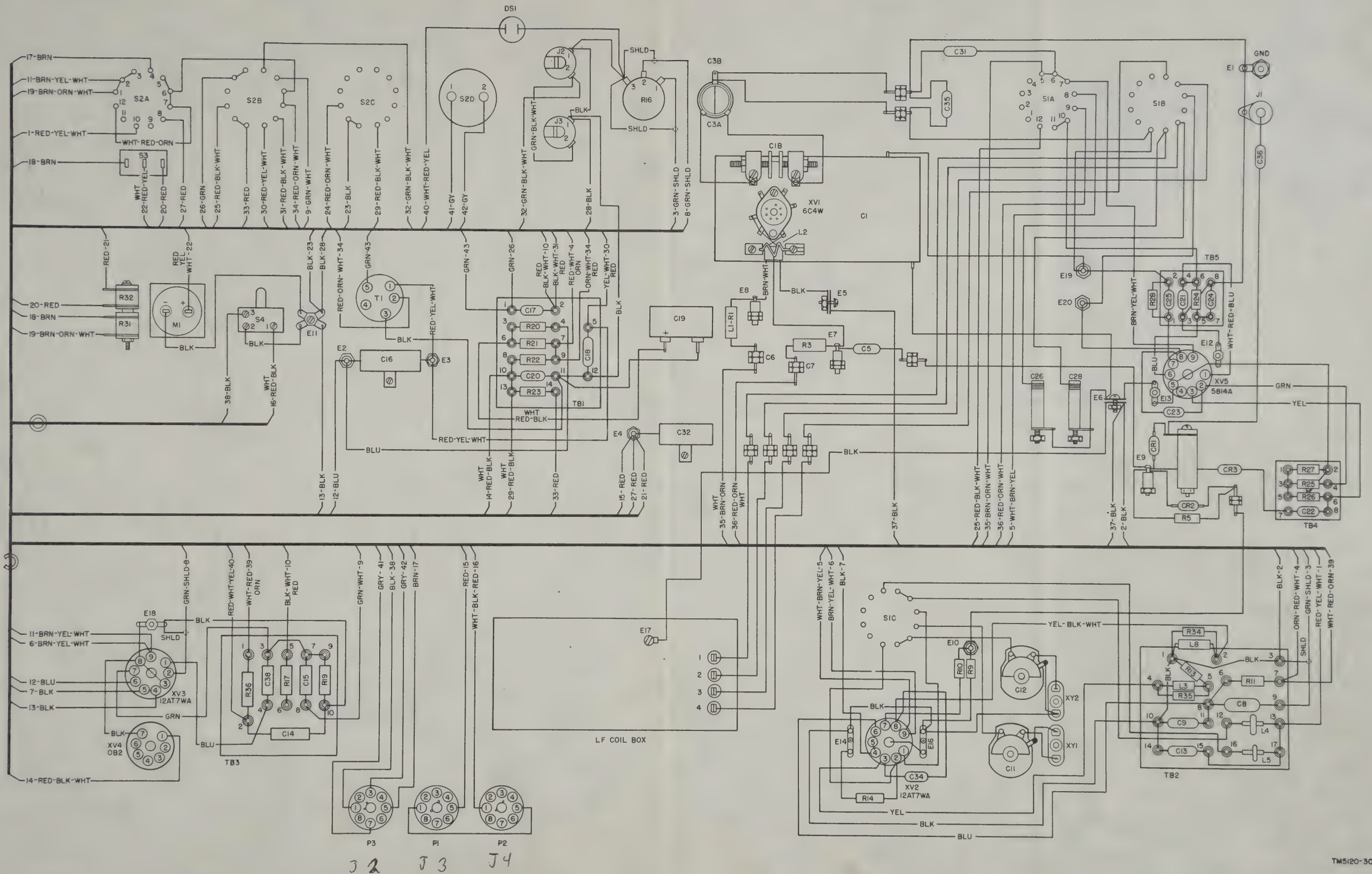
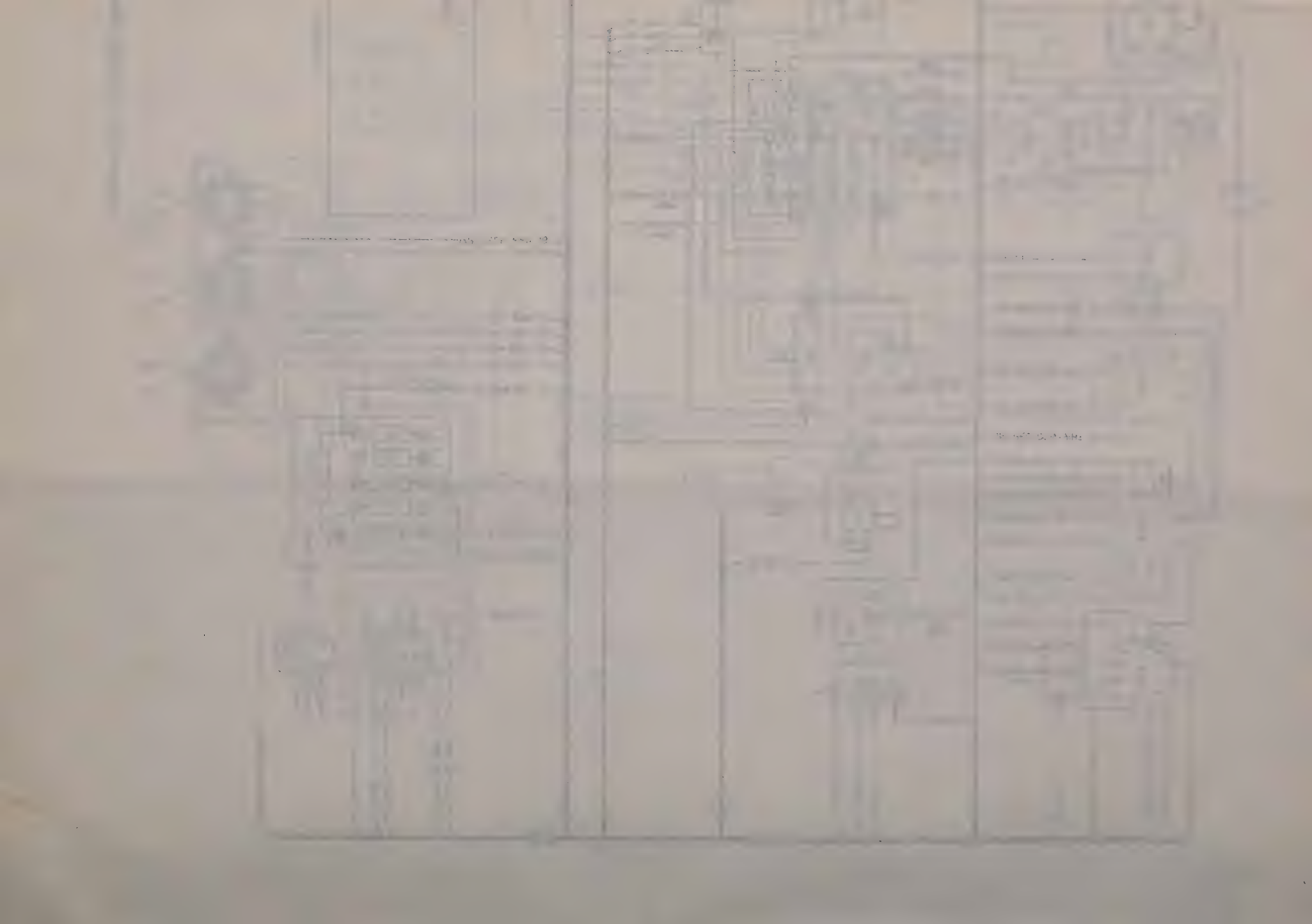


Figure 25. Frequency Meter AN/URM-32, wiring diagram.



INDEX

	Paragraph	Page
Accuracy of calibration	4, 52	3, 41
Accessories	7*b*	4
Additional equipment required	8	5
Adjustments, meter	44	38
AF amplifier and modulator	33	26
Alinement	46	39
Audio output	4	3
Audio power output:		
With external RF input	49	41
With internal crystal oscillator RF input	50	41
Batteries:		
Installation	11*a*	6
Type used	8	5
Beat, zero	26	22
Block diagram	27	22
Book, calibration	14	10
Calibration:		
Accuracy	4, 52	3, 41
Book	14	10
Frequency Meter AN/URM–32	46	39
Test equipment required	45	39
Chart, troubleshooting	39	32
Checking, filament and B+ circuits for shorts	38	32
Checklist, equipment performance	25	20
Circuit analysis	28–34	23–27
Coils, resistance	40	33
Control, AUDIO GAIN	12	8
Connections	11*c*	6
Control, CORRECTOR	12	8
Crystal oscillator, theory	29	23
Dc resistance of transformers and coils	40	33
Description:		
Accessories	7*b*	4
Meter	7*a*	4
Destruction to prevent enemy use	56	43
Dial:		
Hundreds	12	8
Settings, guide	13, 14	9, 10
Units	12	8
Use	12, 13	8, 9
Equipment, installation	11	6
Equipment performance checklist	25	20
Equipment required, additional	8	5
Final testing	47–49	41
Forms	2	3
General precautions	37	32
Guide:		
Dial settings	14	10
Frequencies	14	10
Heterodyne principles	26	22
High-frequency oscillator	31	24
Index for calibration range	14	10
Indexing	14	10
Input power required	4	3
Inspection	22	19
Installation:		
Batteries	11	6
Tubes	11	6
Interpolation	14	10
Lubrication	20	16
Maintenance forms, use	19	16
Maintenance, performing preventive	17–20	16
Measurement, frequency	15	12
Meter, adjustments	44	38
Methods of destruction	56	43
Mixer circuit	32	25
Modulator, AF amplifier and	33	26
Nomenclature and common name	6	4
Operating controls	12	8
Operation	15	12
Packaging data	9*a*	6
Power:		
Input	4	3
Output	4	3
Precautions, general	37	32
Preventive maintenance	18	16
Procedures:		
Starting	13	9
Troubleshooting	35	30
Purpose and use	3	3
Removing contents	9*b*	10
Repackaging for shipment and limited storage	54	43
Repairs	43, 44	38
Replacement of parts	43	38
Resistance, transformers and coils, dc	40	33
Running spares	5	3
Shipment and limited storage	53, 54	43
Signal substitution:		
Notes	41	33
In meter	42	33
Starting procedure	13	9
Stopping procedure	16	15
Technical characteristics	4	3
Test equipment:		
Calibration and alinement	45	39
Final testing	48	41
Troubleshooting	36	31

	Paragraph	Page
Testing, final	47–52	41
Theory	26–34	22–27
Transformer resistance	40	33
Troubleshooting:		
Chart	39	32
Field maintenance level	35–42	30–33
Organizational maintenance level	21–25	19–20
Procedures	35	30
Using equipment performance checklist	24	20
Tools and materials	17	16
Units, dial	12	8
Unpacking	9	6
Use of preventive maintenance forms	19	16
Visual inspection	22	19
Voltage regulator, theory	34	27
Weight	4	3
Zero beat	26	22

[AG 413.6 (16 May 57)]

By order of the Secretaries of the Army and the Air Force:

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White Sands Sig Agency
Yuma Test Sta
Army Elct PG
Sig Fld Maint Shops
Sig Lab
Mil Dist
JBUSMC
Units org under fol TOE:
11–7
11–16
11–57
11–127
11–128
11–500
11–557
11–587
11–592
11–597
39–61
44–415
44–416

NG: State AG; units—same as Active Army.

USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

U. S. GOVERNMENT PRINTING OFFICE: 1957—400619

FREQUENCY METERS AN/URM–32 AND AN/URM–32A AND POWER SUPPLY PP–1243/U

TM 11–5120
TO 33A1–5–65–1
CHANGES NO. 2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *25 October 1960*

TM 11–5120/TO 33A1–5–65–1, 28 May 1957, is changed as indicated so that the manual also applies to Power Supply PP–1243/U.

Change the title of the manual to: FREQUENCY METERS AN/URM–32 AND AN/URM–32A AND POWER SUPPLY PP–1243/U.

POWER SUPPLY

J 2 ↕ P 3

J 3 ↕ P 1

J 4 ↕ P 2

*These changes supersede TB 11-5120-1, 6 September 1957, and so much of DA Supply Manual SIG 7 & 8 PP-1243/U, 23 September 1957, as pertains to first echelon maintenance.

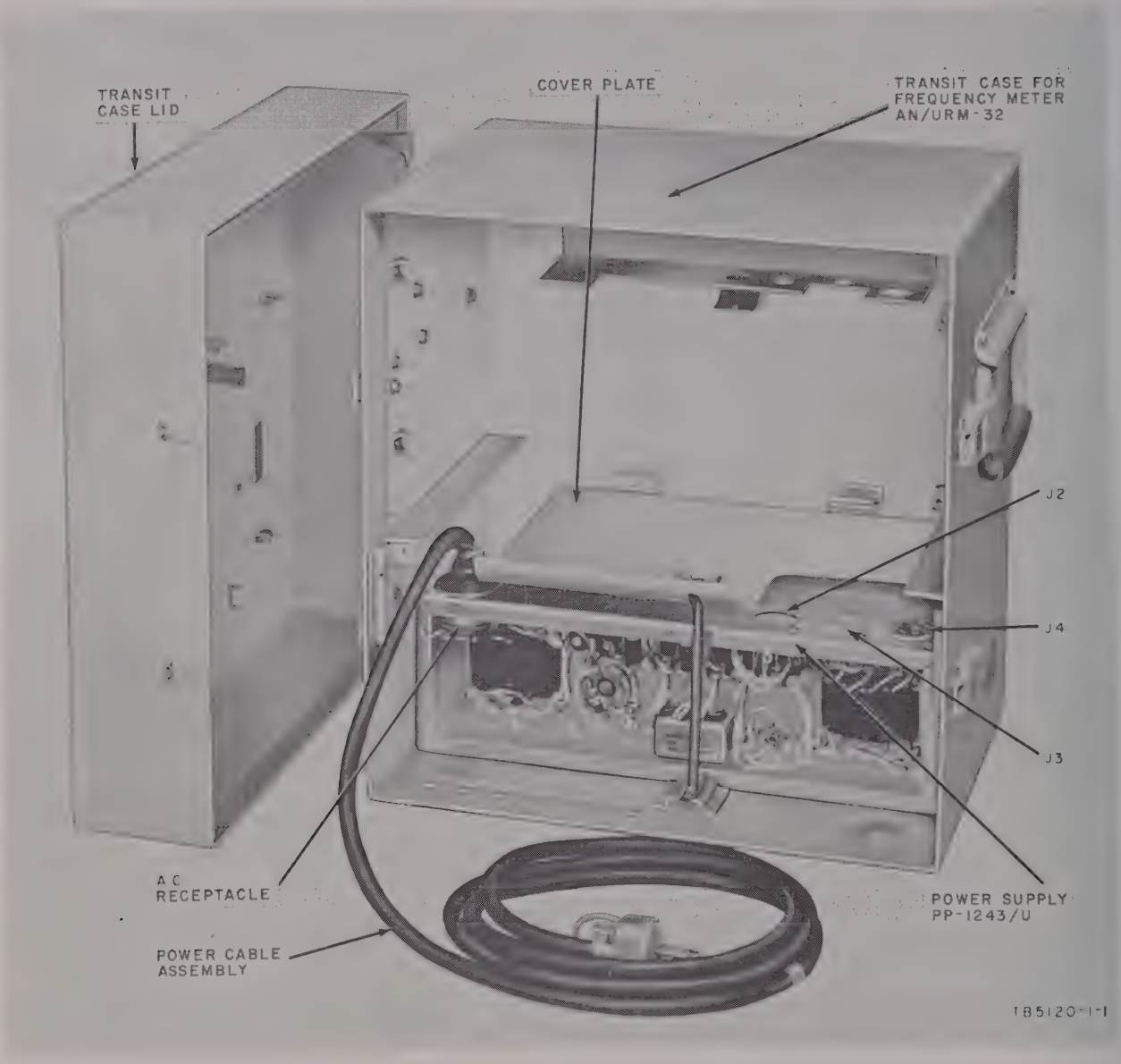

Figure 1.1. Power Supply PP-1243/U with bottom plate removed, installed in frequency meter transit case.

Page 3, Paragraph 1. Delete subparagraph *a* and substitute:

a. This manual covers installation, theory, operation, maintenance, and repair of Frequency Meter AN/URM–32 (fig. 1) and Power Supply PP–1243/U (fig. 1.1).

Paragraph 3. Make the following changes:

Line 1. Delete "(fig 1)."

Precede the text with subparagraph *a* heading as follows:

a. Frequency Meter AN/URM–32 (fig. 1).

Add the following after subparagraph *a*:

b. Power Supply PP–1243/U (fig. 1.1). Power Supply PP–1243/U is alternating-cur rent operated, and replaces the battery supply used with Frequency Meter AN/URM–32. The power supply provides direct current for plate power and ac filament voltage for all the tubes used in Frequency Meter AN/URM–32. Power for the operation of a pilot light is also provided.

Paragraph 4. Make the following changes: Precede the text with subparagraph *a* heading as follows:

a. Frenquency Meter AN/URM–32.

Add the following after subparagraph *a*:

b. Power Supply PP–1243/U.

Voltage input.....115 v or 230 vac.
Input frequency range.....50 to 450 cps.
Voltage outputs.....180 vdc ±5% at 20 ma.
6.3 vac ±5% at 1.1 amp.

Paragraph 5. Make the following changes:

Heading. Add: and Power Supply PP–1243/U.

Subparagraph *a*. Change the heading to: *Components of Frequency Meter AN/URM–32.*

Page 4, paragraph 5. Make the following changes:

Add the following after subparagraph *a*:

a.1 Components of Power Supply PP–1243/U.

Quantity	Item	Height (in.)	Depth (in.)	Length (in.)	Volume (cu in.)	Unit weight (lb)
1	Power Supply PP-1243/U	3¾	1⅜	12	61.87	8½
2	TM 11-5120					
1 set	Running spares (*b.1* below)					

Subparagraph *b*. Change the heading to: *Running Spares for Frequency Meter AN/URM 32.*

Add the following after subparagraph *b*:

b.1. Running Spares for Power Supply PP–1243/U.

Quantity	Item
1	Electron tube, 6X4W
5	Fuse, cartridge, .5 ampere.

Paragraph 6. Make the following changes:

Line 2. After "AN/URM–32" add: and Power Supply PP–1243/U.

Chart. In "Nomenclature" column, under last item, add: Power Suply PP–1243/U. In "Common name" column, under last item, add: Power supply.

Paragraph 7. Add the following after subparagraph *a*:

a.1 Power Supply PP–1243 (fig 1.1). Power Supply PP–1243/U is a light duty power supply built on an aluminum chassis that fits into the bottom section of the transit case used with Frequency Meter AN/URM–32. The power supply chassis is held in position by a cover plate. Pressure is applied to the cover plate by tightening the wingnut on the bolt. All electrical connections are made through four receptacles. One (J1) is for the ac power cable and the remaining three are special octal receptacles (J2, J3, and J4) that mate with three octal plugs that are part of the meter.

Page 5, paragraph 8, line 2. After the word "but," add: either.

Page 6, chapter 2, title. Add: OF FREQUENCY METER AN/URM–32.

CHAPTER 2.1

INSTALLATION AND OPERATION OF POWER SUPPLY PP-1243/U

16.1. Unpacking

a. Packaging Data. When packed for shipment, the power supply is placed in a moisture-vaporproof container and is packed in a wooden box. The box is 15 inches high, 7 inches wide, 10 inches deep, 1,050 cubic inches, and weighs 22 pounds. A typical shipping box and its contents are shown in figure 7.2.

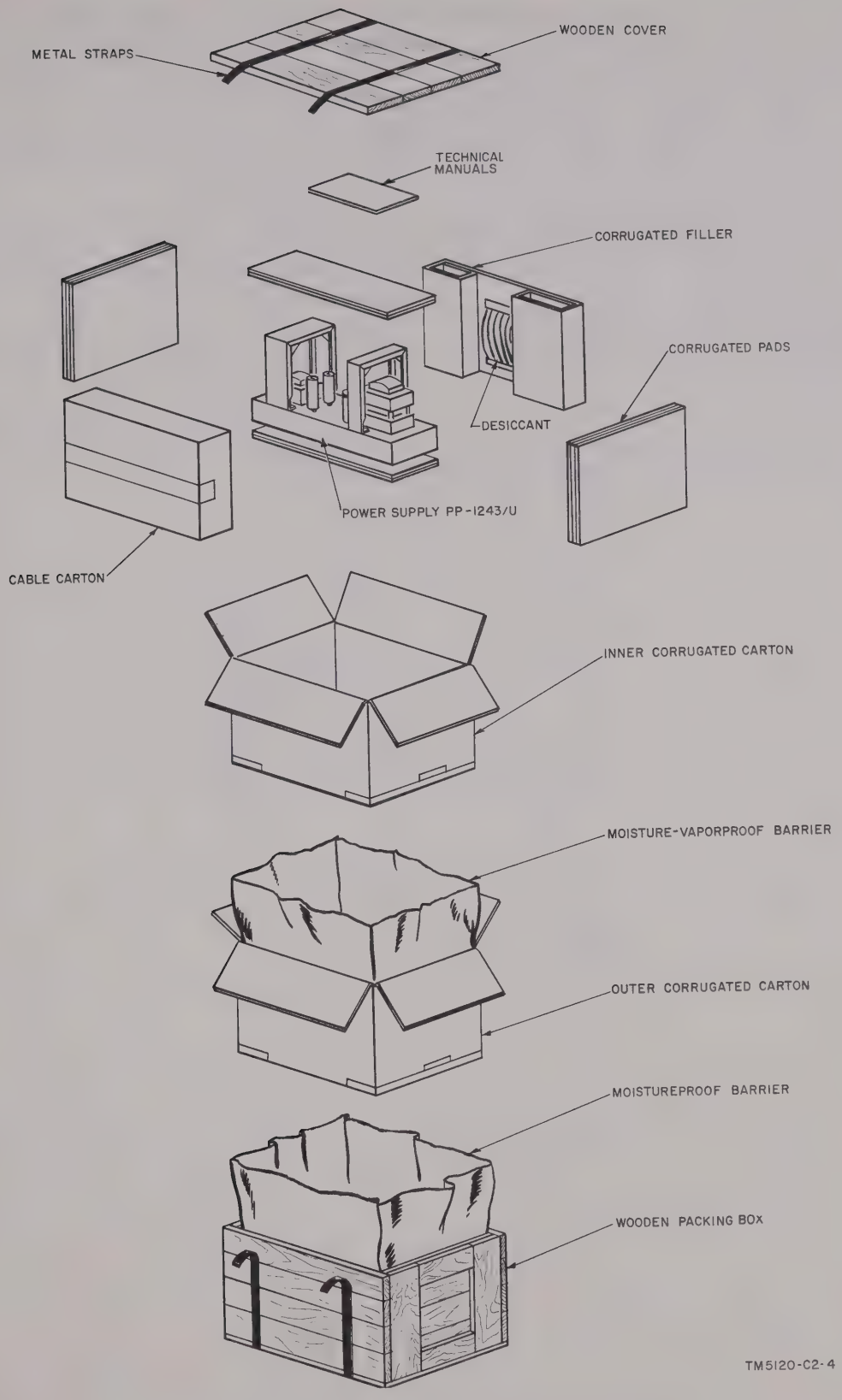

Figure 7.2. Power Supply PP-1243/U, typical packaging.

b. Removing Contents. Unpack the equipment as follows:

(1) Cut and fold back the metal straps.
(2) Remove the nails from the top and one side of the box with a nailpuller. Remove the top and one side. Do not attempt to pry them off; the equipment may become damaged.
(3) Open the moistureproof barrier that covers the carton inside the box. Remove the carton.
(4) Open the carton and the moisture-vaporproof barrier within the carton. Open the inner carton and remove the contents.

16.2. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, refer to paragraph 2.

b. Remove the six screws that secure the bottom cover plate, and remove the cover plate. Shake out any dirt and packing material that may have accumulated during shipment. Replace the cover plate.

c. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check it against the table of components (par. 5).

d. Make a visual check of the tubes to assure that they are not damaged and that they are firmly seated in their sockets.

e. Check ac changeover switch S1 (fig. 7.3) to assure that it is in satisfactory mechanical condition.

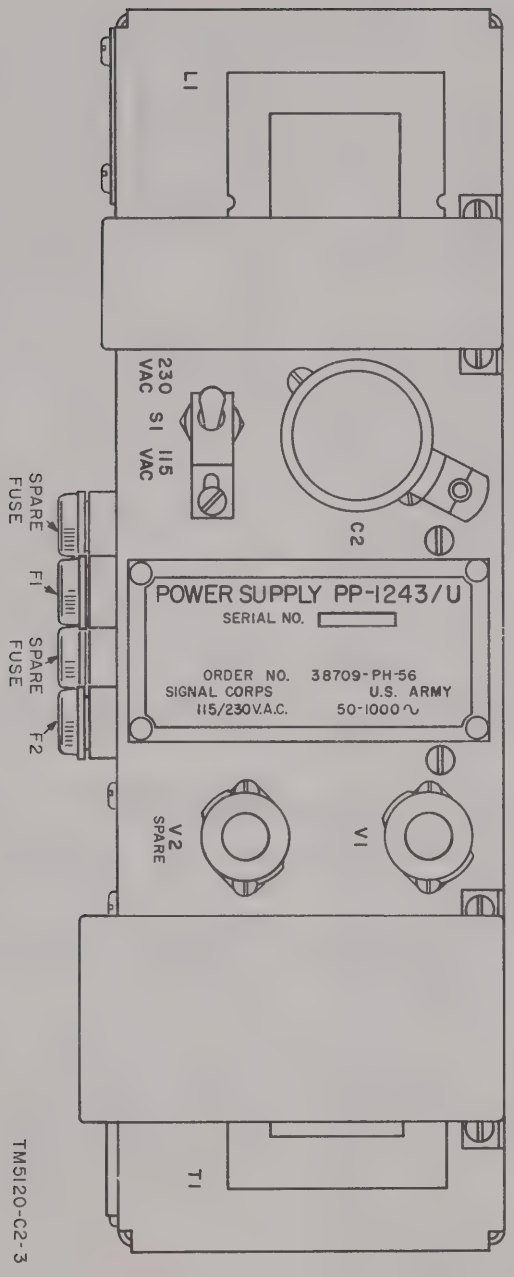

Figure 7.3. Power Supply PP-1243/U.

f. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If modified, the MWO number will appear on the front panel near the nomenclature plate. Check to see that this MWO number also appears on the schematic diagram of the manual accompanying the equipment. If not, add a note to the overall schematic diagram.

16.3. Installation of Power Supply (fig. 1.1)

a. Preparation.

(1) Remove the front cover from the meter transit case by unlatching the four fasteners.

(2) Lift the calibration book holder plate (fig. 2) at the bottom and remove it from its mountings. Remove the battery cover plate by removing the two machine screws at the top.

(3) Take the meter out of the case (par. 43*c*) and remove the cable plugs from the batteries.

(4) Remove the wingnut from the bolt that holds the cover plate, slide the bottom of the bolt from its retaining bracket, and remove the bolt.

(5) Raise the cover plate and remove the batteries.

b. Installation.

(1) Set power supply changeover switch S1 (fig. 7.3) for the voltage (115 or 230 volts) of the available power source.

(2) Put the power supply into the battery compartment as shown in figure 1.1, with the tubes towards the back of the case.

Note. Although not shown in figure 1.1, the power supply chassis bottom plate must be in place when the power supply is installed in the transit case.

(3) Examine the meter cable plugs (previously used as battery plugs) and connect them to the power supply in the following manner:

(*a*) Two cable plugs have keyways spaced 135° apart. Select the plug that has one black lead and one red lead and insert in receptacle J3.

(*b*) Insert the plug that has two red leads into J4.

(*c*) The remaining plug has two keyways spaced 90°. Insert in receptacle J2.

(4) Insert the power cable assembly plug into the ac receptacle (fig 1.1).

(5) Replace the bolt in its retaining bracket.

(6) Lower the cover plate and tighten the wingnut on the bolt.

(7) Replace the meter into the transit case and tighten all panel screws.

(8) Return the battery cover plate and replace the two machine screws at the top.

(9) Return the calibration book holder plate in its mounting.

16.4. Connections

Plug the line cord into a source of ac voltage that corresponds to the setting of ac changeover switch S1 (par. 16. 3*a*). This switch changes connections to the input windings of the power transformer to enable use of either 115 or 230 volt ac line voltage.

16.5. Operation of Power Supply

Power is applied to the power supply when the FUNCTION SW. (pars. 12 and 34*b*) in the meter is in the OPER, CHK, or MOD position.

CHAPTER 3.1
OPERATOR'S AND ORGANIZATIONAL MAINTENANCE OF POWER SUPPLY PP-1243/U
(ADDED)

Section I. OPERATOR'S MAINTENANCE

25.1. Scope of Operator's Maintenance

a. Maintenance duties normally performed by the operator of the meter and power supply are indicated in *b* below. These procedures do not require special tools or test equipment.

b. Operator's maintenance for the power supply consists of the following:

(1) Preventive maintenance (par. 25.3).
(2) Visual inspection (par. 25.4).
(3) Replacement of line fuses (par. 25.5).
(4) Testing and replacement of electron tube (par. 23*b* (1) and (2).

25.2. Tools and Materials

Tools and materials required for operator's maintenance are listed in paragraph 17.

25.3. Preventive Maintenance Forms

When the power supply is placed into use it becomes a part of Frequency Meter AN/URM–32. For operator's preventive maintenance on the power supply, perform applicable items given in figures 8 and 9.

25.4. Visual Inspection

a. When the equipment fails to perform properly, turn off the power and check the items in (1) and (2) below. *Do not check any item with the power on.*

(1) Defective line cord.
(2) Defective or loose connectors (calibration book holder and cover plate must be removed (par. 16.3*a*)).

b. If the above checks do not locate the trouble, higher echelon repair is required.

25.5. Replacement of Line Fuses (fig. 7.3).

a. Expose the power supply by removing the calibration book holder and cover plate (par. 16.3*a*).

b. Rotate the fuseholder counterclockwise, and pull out.

c. Replace the defective fuse with spare.

d. Press the fuseholder in its receptacle and turn clockwise.

Section II. UNIT REPAIRMAN'S MAINTENANCE

25.6. Scope of Unit Repairman's Maintenance

a. Maintenance duties performed by the unit repairman are listed in *b* below. The scope of maintenance is determined by the available tools, materials, test equipment, and spare parts, and by the MOS of the unit repairman.

b. Unit repairman's maintenance of the power supply consists of the following:

(1) Troubleshooting (par. 25.8).
(2) Testing and replacement of electron tubes (par. 23*b* (1) and (2)).
(3) Repair of defective cords.
(4) Preventive maintenance (par. 25.3).
(5) Replacement of line fuses (par. 25.1*b* (3)).

25.7. Tools and Materials

Tools and materials required for organizational maintenance are listed in paragraph 17.

25.8. Troubleshooting

a. General. The equipment performance checklist is a procedure to systematically check equipment performance. All corrective measures which the unit repairman can perform are given in the *Corrective measures* column. When using the checklist, start at the beginning and follow each step in order. If the corrective measures indicated do not repair the equipment, troubleshooting is required by higher echelon. Note on the repair tag how the equipment performed and what corrective measures were taken.

b. Procedure. Place the power supply in operation (par. 16.5). Allow the equipment to warm up for 5 minutes. Operate the power supply as shown in the checklist in *c* below:

c. Equipment Performance Checklist. The steps listed below supplement the equipment performance check in paragraph 25 when ac power is used with the meter.

Step	*Item*	*Action*	*Normal indication*	*Corrective measures*
1	Line cord	Connect line cord to source of ac power.		
2	FUNCTION SW	Turn to OPER position.	POWER lamp on meter lights.	Check lamp; check fuse F1 and F2 (par. 255); check cable connections.
3	VOLTAGE switch	Place in A position.	VOLTAGE meter indicates in green area.	Check cable connection to J2.
4	VOLTAGE switch	Place in B position.	VOLTAGE meter indicates in green area.	Check rectifier tube 6X4; check cable connections to J3 and J4; check C2.
5	FUNCTION SW	Turn to off.	POWER lamp goes out.	

Page 22, chapter 4, title. Add: OF FREQUENCY METER AN/URM–32.

CHAPTER 4.1

THEORY OF POWER SUPPLY PP-1243/U

34.1. General

This chapter covers the theory of operation of the power supply. The power supply consists of a 230/115-volt changeover circuit, a full-wave rectifier, and a filter circuit. It furnishes 180 volts dc and 6.3 volts ac to the meter from a power source of 115 or 230 volts at a frequency of 50 to 450 cycles per second.

34.2. Ac Changover Circuit (fig. 17.2)

Power is applied to the primary of power transformer T1 through the ac receptacle. The equipment is protected for overloads by line fuses F1 and F2. One side of the ac line is wired to pin 3 of J2. The FUNCTION SW. of the meter is connected in series with pins 3 and 7 of J2 and provides a means of turning the power supply on or off. Primary windings 1–2 and 3–4 are connected in parallel when S1 is in the 115 VAC position. When S1 is in the 230 VAC position, windings 1–2 and 3–4 are connected in series, thus providing a lower step-up ratio. The .05 capacitor, C1A and C1B, filters RF radiation from the meter out of the ac line.

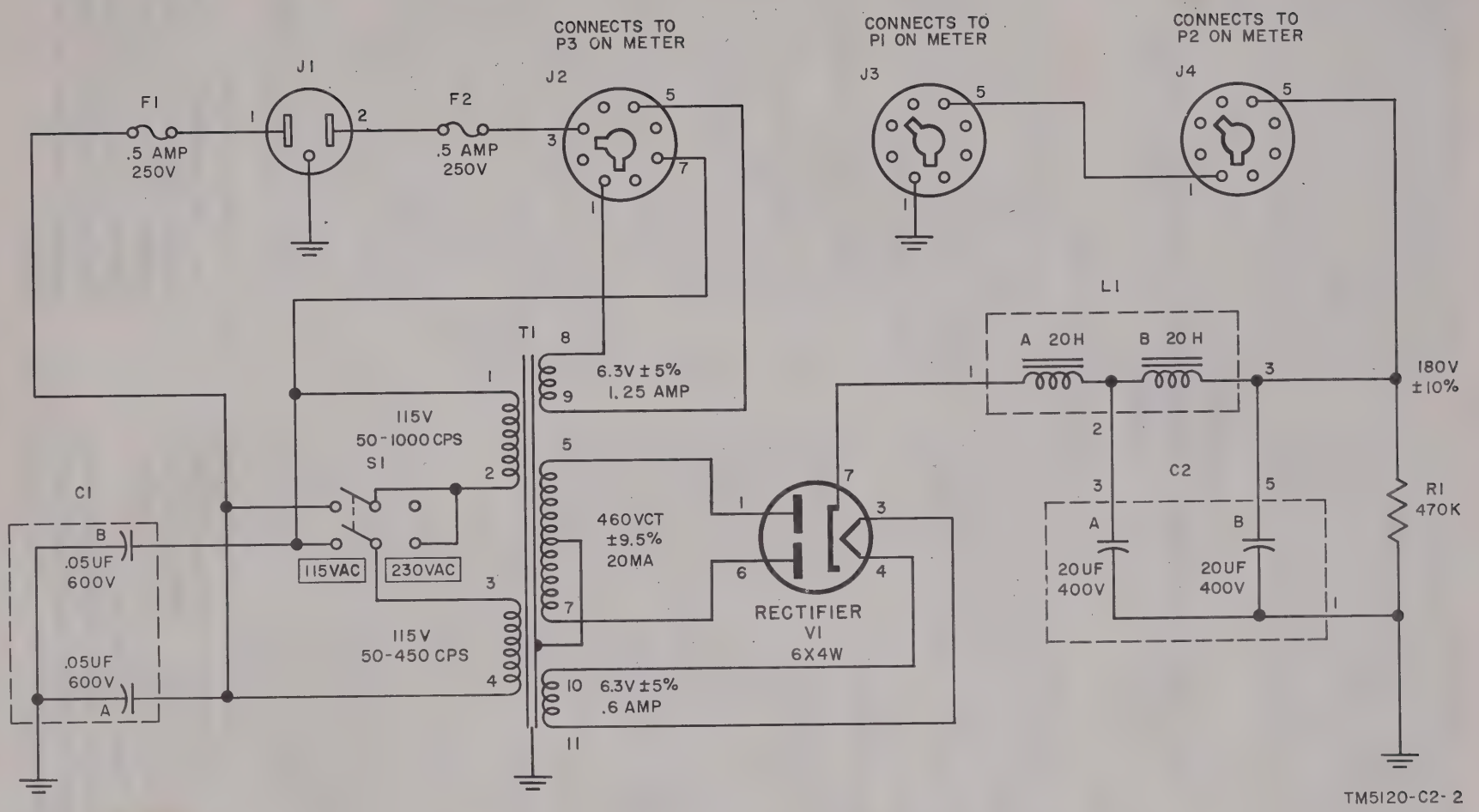

Figure 17.2. Power Supply PP-1243/U, schematic diagram.

34.3. Rectifier and Filter Circuit
(fig. 17.2)

Winding 5 and 7, with a grounded center tap, is connected to the plates of V1, which is used as a full-wave rectifier. Winding 10 and 11 provides the filament voltage for the rectifier. Winding 8 and 9 provides the filament voltage for the tubes in the meter. The rectifier filter uses a choke-input circuit which consists of L1B, C2A, and C2B. Resistor R1 serves as a bleeder. B+ is supplied to the meter through receptacles J3 and J4.

Page 30, chapter 5, title. Add: OF FREQUENCY METER AN/URM–32.

CHAPTER 5.1
FIELD MAINTENANCE OF POWER SUPPLY PP-1243/U
(ADDED)

Section I. TROUBLESHOOTING

Warning: When servicing the power supply, be extremely careful of the high voltage in the power transformer and rectifier circuit. Disconnect the power cable and discharge the filter capacitors before attempting any resistance measurements.

52.1. General Instructions

Troubleshooting at field and depot maintenance level includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. The field and depot maintenance procedures are not complete in themselves but supplement the procedures described in organizational maintenance. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at an organizational level, must be completed by means of sectionalizing, localizing, and isolating techniques.

52.2. Troubleshooting Procedure

a. General. The first step in servicing a defective power supply is to sectionaize the fault. Sectionalization means tracing the fault to a major component or circuit responsible for abnormal operation. The second step is to localize the fault. Localization means tracing the fault to a defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers can often be located by sight, smell, and hearing. The majority of faults must be localized by checking voltages and resistance.

b. Sectionalization. Listed below is a group of tests arranged to reduce unnecessary work, and to aid in tracing trouble in a defective power supply.. This power supply consists of three circuits: the ac changeover switch and associated circuit, the power transformer and rectifier circuit, and the filter circuit. Locate the section at fault by the following methods:

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, these tests will help in determining the exact nature of the fault. The equipment performance checklist (par.25.8) is a good operational test.

c. Localization. The tests listed below will aid in isolating the trouble. Localize the trouble to a single circuit, and then isolate the trouble within that circuit by voltage, resistance, and continuity measurements. Use the following methods of trouble localization:

(1) *Voltage and resistance measurements.* The voltage and resistance measurements (par. 52.6) will help locate the individual part at fault.

(2) *Troubleshooting chart.* The trouble symptoms listed in paragraph 52.4*b* will aid in localizing trouble to a part.

(3) *Intermittent troubles.* In all these tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the power supply. Check the wiring and connections to the frequency meter.

52.3. Test Equipment Required

Multimeter AN/URM–105 is required. It is described in TM 11–6625–203–12.

52.4. Localizing Troubles

a. Use of Chart. The troubleshooting chart is designed to supplement the operational checks detailed in the equipment performance checklist (par. 25.8*c*). If no operational symptoms are known, begin with item 1 of the equipment performance checklist and proceed until the trouble is located.

b. Troubleshooting Chart (figs. 7.3 and 21.1).

Item	Indication	Probable trouble	Procedure
1	Power supply dead	Fuse F1 of F2 blown	Replace fuse. If the fuse blows again, check for shorted C2 or V1, or faulty meter circuitry.
		Defective rectifier tube V1	Replace V1.
		Defective power transformer T1	Check transformer, replace if necessary.
2	Tube V1 lights up but no voltage appears at J4.	Defective rectifier V1	Replace V1.
		Open L1	Check continuity of L1 and replace if necessary
		Defective power transformer T1	Check continuity of winding 5 and 7. Replace transformer T1 if necessary.
3	Output voltage low	Defective rectifier tube V1, filter component, or faulty meter circuitry	Check V1, L1, and C2. Replace if necessary. Check power supply without meter connected.
4	Output voltage too high	No load on power supply	Check cable connections to J3 and J4.

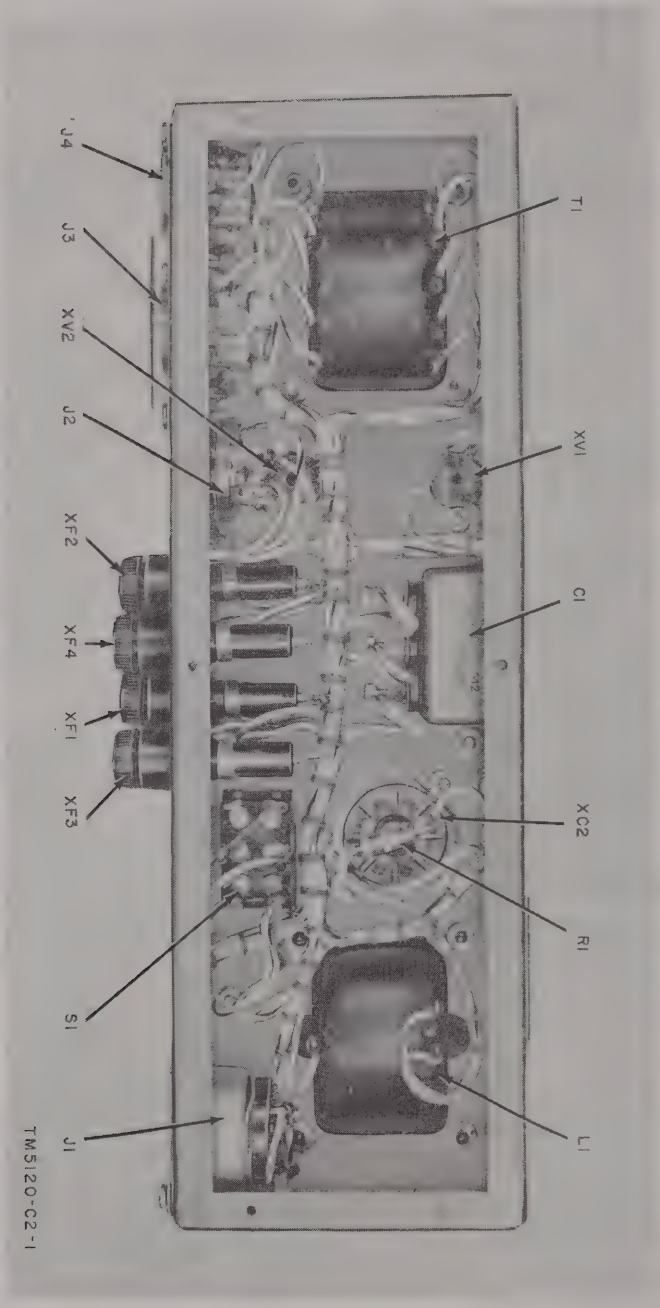

Figure 21.1. Power Supply PP-1234/U, location of components.

SECTION II. REPAIRS

52.5. General Repair Instructions

Most of the parts in the power supply can be reached easily and replaced without special procedures.

a. When the power supply is to be operated outside the frequency meter cabinet, pins 3 and 7 of J2 must be jumpered to complete the primary ac path.

b. Always check the position of ac changeover switch S1 (fig. 7.3) before connecting the power supply to a source of ac.

52.6. Voltage and Resistance Measurements

All voltage and resistance measurements are made to ground, except filament windings which are measured from pin to pin. Use Multimeter AN/URM–105 or equal for all measurements. Remove the power cord and discharge all capacitors before attempting any resistance measurements.

a. Voltage Measurements. The measurements listed below are correct when a source voltage of 115 volts ac is used.

Tube	Pin 1	Pin 2	Pin 3*	Pin 4*	Pin 5	Pin 6	Pin 7
6X4W	230 vac	0	0	0	0	230 vac	195 vdc

*Measurement taken between pins 3 and 4 is 6.7 vac.

b. Resistance Measurements.

Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
6X4W	245 ohms					245 ohms	400K ohms

Section III. FINAL TESTING

52.7. General

This section is intended as a guide to be used in determining the quality of a repaired power supply. The minimum test requirements may be performed by maintenance personnel with adequate test equipment and necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

52.8. Test Equipment Required for Final Testing

Nomenclature	Federal Stock No.	Reference
Voltmeter, Electronic ME-30A/U.	6625 669 0742	TM 11-5152
Transformer CN-16A/U	5950 235 2086	None
Multimeter AN/URM-105	6625 581 2036	TM 11-6625-203-12

52.9. Ac Input Voltage Check

The accurary of the output voltage measurements depends upon the ac input voltage being within 10 percent of its rated value (115 or 230 volts ac). To correct the input voltage, connect Transformer CN–16A/U to the ac source and adjust the input voltage to the desired value.

52.10. Final Test Procedure (fig. 17.2)

Remove the power supply by following a procedure similar to those listed in paragraph 16.3*a* which describes the removal of batteries. Connect the power cable to the ac source or to transformer CN–16A/U, if used. The frequency meter must remain connected to the power supply when the following tests are performed:

a. Output Ripple Voltage. Connect Electronic Multimeter ME–30A/U between pin 5 of J4 and ground. The total ripple voltage measured should be less than 0.03 volt ac.

b. Output Load Resistance. Determine the output dc load resistance of the power supply as follows:

Note. When performing the procedure in (5) below the power supply chassis must not physically contact the meter chassis or meter case.

(1) Turn the FUNCTION SW. on the meter to OFF.
(2) Remove P1 plug from J3.
(3) Set up Multimeter AN/URM–105 for dc current measurements (TM 11-

6625–203–12) and connect it between pin 1 of J3 and pin 1 of P3.
(4) Turn the FUNCTION SW. to OPER.
(5) Obtain a dc reading on Multimeter AN/URM–105.
(6) Turn the FUNCTION SW. to OFF.
(7) Disconnect Multimeter AN/URM–105 and restore connection between J3 and P1.
(8) Set up Multimeter AN/URM–105 for dc voltage measurements and connect it between pin 5 of J4 and ground.
(9) Turn the FUNCTION SW. to OPER. and obtain a voltage reading.
(10) The value of current measured ((5) above) divided into the output voltage ((9) above) should provide an output load resistance of 9K ±10 percent.

APPENDIX I
MAINTENANCE ALLOCATION FOR POWER SUPPLY PP-1243/U
(Added)

1. General

a. This appendix assigns maintenance functions and repair operations to be performed by the lowest appropriate maintenance echelon. It also specifies the tools and other equipment authorized at each echelon to perform the assigned maintenance functions.

b. Columns in the maintenance allocation chart are as follows:

(1) *Part or component.* Only the nomenclature or standard item name is shown in this column. Additional descriptive data are included only where clarification is necessary to identify the part. Components and parts making up the major end item are listed alphabetically. Assemblies and subassemblies are in alphabetical sequence with their components listed alphabetically immediately below the assembly listing.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelon capable of performing the operation. These are defined as follows:

(a) Service. To clean, to preserve, and to replenish fuel and lubricants.

(b) Adjust. To regulate periodically to prevent malfunction.

(c) Inspect. To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.

(d) Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.

(e) Replace. To substitute serviceable assemblies, subassemblies, and parts for unserviceable components.

(f) Repair. To restore to a serviceable condition by replacing unserviceable parts or by any other action required utilizing tools, equipment, and skills available, to include welding, grinding, riveting, straightening, adjusting, etc.

(g) Align. To adjust two or more components of an electrical system so that their functions are properly synchronized.

(h) Calibrate. To determine, check, or rectify the graduation of an instrument, weapon, or weapons system, or components of a weapons system.

(i) Rebuild. To restore to a condition comparable to new by disassembling the item to determine the condition of its component parts and reassembling it using serviceable, rebuilt, or new assemblies, subassemblies, and parts.

(3) *1st, 2d, 3d, 4th, and 5th echelon.* The symbol X indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates

codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The numbers in column 8 of the maintenance allocation chart indicate the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Column 9 contains any notations necessary to clarify the data cited in the preceding columns.

c. Columns in the allocation of tools for maintenance functions are as follows:

(1) *Tools required for maintenance functons.* This column lists the tool and test equipment required to perform the maintenance functions.

(2) *1st, 2d, 3d, 4th and 5th echelon. A* dagger symbol (†) indicates that the tool or test equipment is allocated to that echelon.

(3) *Tool code.* This column lists the tool code assigned.

2. Maintenance by Using Organizations

When this equipment is used by signal service organizations organic to theater headquarters or communication zones, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

3. Mounting Hardware

The basic entries of the maintenance allocation chart do not include mounting hardware such as screws, nuts, bolts, washers, brackets, and clamps.

Maintenance Allocation Chart

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH	(4) 2ND ECH	(5) 3RD ECH	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
POWER SUPPLY PP 1243/U	service				X	X	7	
	adjust				X	X	8	
	inspect							Visual
	test				X		1, 2, 3, 4, 5, 6, 7, 8, 9, 10	
	repair				X			
	rebuild					X		
CABLE ASSEMBLY, POWER, ELECTRICAL	replace		X					
	repair		X					
CABLE, POWER, ELECTRICAL	replace		X					
CONNECTORS	replace		X					
CAPACITOR: C2A, C2B	replace		X					
CAPACITORS	replace				X			
CONNECTORS	replace				X			
ELECTRON TUBE	replace	X						
FUSEHOLDERS	replace				X			
FUSES	replace	X						
REACTOR	replace				X			
RESISTOR	replace				X			
RETAINER, ELECTRON TUBE	replace		X					
SHIELD, ELECTRON TUBE	replace		X					
SOCKETS, ELECTRON TUBE	replace				X			
STUD, THREADED	replace				X			
SWITCH, TOGGLE	replace				X			
TRANSFORMER, POWER	replace				X			

Allocation of Tools for Maintenance Functions

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	1ST ECH	2ND ECH	3RD ECH	4TH ECH	5TH ECH	TOOL CODE	REMARKS
PP-1243/U (continued)							
AMMETER ME-65/U				†	†	1	
MULTIMETER AN/URM-105				†	†	2	
SHUNT, INSTRUMENT MULTI-RANGE MX-1471/U				†	†	3	
OHMMETER ZM 21/U				†	†	4	
TEST SET, ELECTRON TUBE TV-2/U					†	5	
TEST SET, ELECTRON TUBE TV-7/U				†		6	
TOOL EQUIPMENT TK-21/G				†	†	7	
TRANSFORMER CN-16/U				†	†	8	
VOLTMETER TS-340/U				†	†	9	
VOLTMETER METER ME-30/U				†	†	10	

APPENDIX II

BASIC ISSUE ITEMS FOR POWER SUPPLY PP-1243/U
(Added)

Section I. INTRODUCTION

1. Scope

This appendix lists items supplied for initial operation and for running spares. The list includes parts and material issued as part of the major item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

2. The columns are as follows:

a. Source, maintenance, and Recoverability Code. Not used.

b. Federal Stock Number. The column lists the 11-digit Federal stock number.

c. Designation by Model. Not used.

d. Description. Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning, enter the nomenclature and description on the requisition.

e. Unit of Issue. The unit of issue is the supply term applied to the smallest quantity by which the individual item is counted for procurement, storage, requisitioning, allowances, and issue purposes.

f. Expendability. Expendable items are indicated by the letter X; nonexpendable items are indicated by NX.

g. Quantity Authorized. Under "Items Comprising an Operable Equipment," the column lists the quantity of items supplied for the initial operation of the equipment. Under "Running Spares and Accessory Items," the quantities listed are those issued initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.

h. Illustrations. Not used.

Section II. BASIC ISSUE ITEMS LIST

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO.	(9) ILLUSTRATIONS ITEM NO.
			ITEMS COMPRISING AN OPERABLE EQUIPMENT					
			POWER SUPPLY, PP 1243/U					
	6625-542-6217		POWER SUPPLY PP-1243/U:	ea	NX			
	6625 542-6238		CABLE ASSEMBLY, POWER, ELECTRICAL: SigC dwg No. SM B-136168	ea	X	1		
	5910 126-9613		CAPACITOR, FIXED, ELECTROLYTIC: MIL type CE52C200Q	ea	X	1		
	5920 199-9498		FUSE, CARTRIDGE: Buss type MDL-1/2	ea	X	2		
	5960-188-0880		ELECTRON TUBE: MIL type 6X4W	ea	X	1		
	5960-223-4598		RETAINER, ELECTRON TUBE: Timesfax No. 3T Hat	ea	X	1		
			RUNNING SPARES AND ACCESSORY ITEMS					
			POWER SUPPLY, PP-1243/U					
	5920-199-9498		FUSE, CARTRIDGE: Buss type MDL-1/2	ea	X	5		
	5960-188-0880		ELECTRON TUBE: MIL type 6X4W	ea	X	1		

Page 46. Make the following changes: Figure 24 (fold-out). In the lower right-hand section of the schematic illustration, interchange the power plug reference symbols P1 and P3.

Figure 25 (fold-out). In the lower left-hand section of the wiring diagram, interchange the power plug reference symbols P1 and P2.

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11-8
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11-55
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11-557
11-587
11-592
11-597
17
17-32
17-51
17-52
17-115
17-116
29-7
29-51
29-55
29-56
39-61
39-71
44-8
44-500 (AA-AB)
55-27
57

NG: State AG (3); units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

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